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Breast-Feeding, Fertility, and Family Planning

Editors' Summary Breast-feeding is the best form of nutrition for the young infant and an important means of spacing births. In most developing countries almost all women breast-feed their children initially, but there is evidence that the length of breast-feeding is declining, especially in urban areas. Family planning workers should encourage women to start and to continue breast-feeding because it is important for infant health and contributes to child-spacing. It is unreliable as a method of family planning for individual women, however. After 6 to 12 months or as soon as the infant begins to receive a substantial amount of other food regularly and suckles at the breast less often, fecundity is likely to return, and effective contraception is needed to avoid another pregnancy.

Breast milk has special properties that make it superior to even the most carefully made home or commercial preparations. It not only provides immunological protection against common childhood illnesses such as diarrhea and respiratory disease but also helps to maintain a protective environment within the intestine. It contains the complete range of nutrients necessary to the young infant and is easier to digest than substitutes.

In developing countries, infants may face special hazards when breast-feeding is curtailed. The high cost of proper bottle-feeding—$200 to $300 (US) in the first year—may lead parents to dilute commercial or home preparations. Water supplies are often polluted, and facilities for sterilization and refrigeration are scarce. As a result, bottle-fed babies are more likely than breast-fed babies to be malnourished, to be sick, and in some cases to have higher death rates. Although upper income families usually can compensate for some of the disadvantages of bottle-feeding, poor families who start to bottle-feed without realizing all the problems that are involved may be endangering a child's health.

Breast-Feeding Declines

Recent evidence suggests that the length of breast-feeding in many developing countries is declining. For example, in Taiwan and Thailand over the last decade the average length of breast-feeding has dropped by about five months. Better educated, more affluent, urban women are likely to breast-feed for shorter periods if at all. By contrast, in the US, Sweden, and Australia, breast-feeding is becoming more prevalent, especially among educated women, although the average length of breast-feeding remains short.

At any one time 30 to 40 percent of married women of reproductive age in developing countries may be breast-feeding. The percentage of women who breast-feed *initially* is high throughout the developing world—about 90 percent in 28 countries surveyed. But there is some variation—for example, between Bangladesh, where 98 percent of women start breast-feeding, and Costa Rica and Malaysia, where 74 percent start. There is even more variation in the *length* of breast-feeding—from 30 months in Bangladesh to 2 in Costa Rica.

Why are women in developing countries breast-feeding less? The reason most commonly given in surveys is "insufficient milk." Yet well-nourished women in cities and developed areas are more likely to give up breast-feeding than malnourished rural women who may produce less milk. Women who say that they do not have enough milk may actually not know how to breast-feed properly, or may not have the help and support they need from family or friends, or may prefer not to breast-feed for other reasons. Some advocates of breast-feeding blame widespread advertising and promotion of infant formula for the decline of breast-feeding. Others cite practices of hospitals and health personnel which separate the mother and newborn infant and sometimes discourage breast-feeding. Still other observers note that more women now work in nonagricultural jobs where it is difficult to breast-feed.

Physiologically, the amount of milk a woman produces depends much more on the frequency, duration, and intensity of infant suckling than on maternal nutrition, age, or parity. Thus rural women, even if they are poorly nourished, can often breast-feed for prolonged periods because infants may suckle 12 to 14 times a day. Women who try to adopt a regular 3- to

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This issue of **Population Reports** was prepared by **Margaret F. McCann**, M.S., **Laurie S. Liskin**, M.A., **Phyllis T. Piotrow**, Ph.D., **Ward Rinehart**, and **Gordon Fox** on the basis of published and unpublished materials, correspondence, and interviews. Comments and additional material are welcome.

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Phyllis T. Piotrow, Ph.D., Director; Walter W. Sterden, Associate Director; Ward Rinehart, Editor

4-hour schedule, however, may find that their milk supply diminishes as nursing frequency is reduced and other infant foods are introduced.

Contraception and Breast-Feeding

In general, the longer a woman continues to breast-feed, the longer she will be protected against pregnancy. Full breast-feeding, with frequent suckling, night feeding, and no other food for the infant, delays the return of fertility longest because it allows for the most suckling. As suckling diminishes, so does milk production and the protection against pregnancy. But even in fully breast-feeding women, ovulation may occur and menses resume. By six months about 20 to 50 percent of breast-feeding women are menstruating and need contraception just as much as if they were not breast-feeding.

With respect to contraception and breast-feeding, two different concerns must be addressed: (1) during prolonged breast-feeding, contraception is needed to prevent another pregnancy too soon; and (2) where the duration of breast-feeding is declining, greater contraceptive use is needed to prevent fertility from increasing.

Most contraceptive methods—IUDs, voluntary sterilization, barrier methods, withdrawal, and abstinence—have no effect on lactation. They can be used as safely by breast-feeding women as by other women. With respect to hormonal contraceptives, some questions have been raised and not yet resolved. A number of studies suggest that combined estrogen-progestin oral contraceptives may reduce the amount of breast milk or the length of lactation in some women. Infant growth has not been affected, however, by pills containing 0.05 mg or less of estrogen. Still, some authorities advise against using any combined oral contraceptive—at least until lactation is well-established. Progestin-only contraceptives either have no impact or, in the case of some compounds, such as depot medroxyprogesterone acetate (DMPA), appear to increase the volume of breast milk produced. With all hormonal contraceptives, a small amount of hormone reaches the breast-fed infant. Although long-term research has not been conducted, there have been no reports of serious adverse effects to date.

Implications for Family Planning Programs

Before definitive guidelines on breast-feeding and contraception can be established, a better understanding of breast-feeding and lactational infecundity is needed, along with detailed knowledge of local conditions and individual experience. Still, these suggestions are offered as reasonable options, based on current knowledge and program experience:

- All women should be encouraged to breast-feed their children initially and for as long as feasible.
- Extra food for the mother should begin at the start of pregnancy and continue throughout lactation to help maintain the mother's nutritional status and perhaps also to improve her breast-feeding performance.
- Breast milk alone is usually sufficient for the infant until four to six months of age if the mother is adequately nourished. After four to six months an infant should receive supplemental feedings.
- A fully breast-feeding woman usually does not need contraception before six months postpartum. Sometimes, however, IUD insertion or voluntary sterilization can be performed just after delivery. Supplies and instructions for other methods can be provided then or at a postpartum checkup.
- To minimize any adverse impact on milk volume or length of lactation, or any drug transfer, progestin-only pills may be the best hormonal method, followed by injectables or the lowest available dose of combined pills (0.05 mg or less estrogen). The US Agency for International Development (USAID) plans a limited purchase of progestin-only pills in 1982. Where progestin-only methods are not available, the advantages of low-dose combined pills in preventing another pregnancy—with its reduction in milk supply and strain on maternal health—may outweigh any potential disadvantages.
- No universal rule is possible to determine when a breast-feeding woman can start hormonal methods. A woman who allows frequent suckling day and night with little supplementation and is not menstruating might reasonably wait 12 or 18 months to start combined pills or might start progestin-only methods earlier. A woman on a 3- to 4-hour, day-only feeding schedule who gives the infant other food early might reasonably start two or three months after delivery.
- Waiting for first menses involves some risk of pregnancy, but after first menses effective contraception is essential. Supplies and instructions should be ready in advance.
- To maintain adequate milk supply, frequent suckling should be encouraged. When mothers start hormonal contraceptives, they should be cautioned about changes in their activities that might interfere with the frequency and duration of suckling.
- Family planning programs should provide a range of methods, including hormonal and nonhormonal methods, for breast-feeding women. Programs that either do not offer nonhormonal methods or discourage use of hormonal methods during lactation may increase the risk that women will stop breast-feeding in order to use the method which is available or preferred or, alternatively, that they will become pregnant while breast-feeding.

An unwanted pregnancy during breast-feeding is a proven and serious risk to the health of the mother and eventually to the health of both children. Avoiding such pregnancies should have high priority for family planning and maternal and child health personnel. **End of Editors' Summary.**

BENEFITS OF BREAST-FEEDING

Breast milk is the best food for infants, and no substitute food exactly duplicates it. Studies of breast milk and breast-feeding show that:

- Breast milk provides some immunological protection for the infant.
- Breast milk best satisfies the infant's nutritional needs.
- Breast-feeding costs less than feeding with substitutes.
- Because of the immunological and nutritional advantages of breast milk and because preparing substitutes properly is difficult in much of the developing world, breast-fed infants are less likely to develop infections or malnutrition.
- Breast-feeding protects against pregnancy, although the length of this contraceptive effect is not predictable.

Many other advantages have been claimed for breast-feeding, ranging from closer emotional ties between mother and child to greater intellectual ability in later life for the breast-fed child. Such possible benefits are difficult to measure, and more research will be necessary before any or all can be accepted.

Immunological Protection

A major advantage of breast-feeding is immunological protection. Unlike other infant foods, both colostrum and mature breast milk contain biologically active substances that guard the infant against infection (89, 214, 274, 330, 366, 439, 470, 595, 604). The concentration of these substances is highest in the colostrum, the high protein fluid secreted in the first days postpartum, when the infant's immune system is still immature.

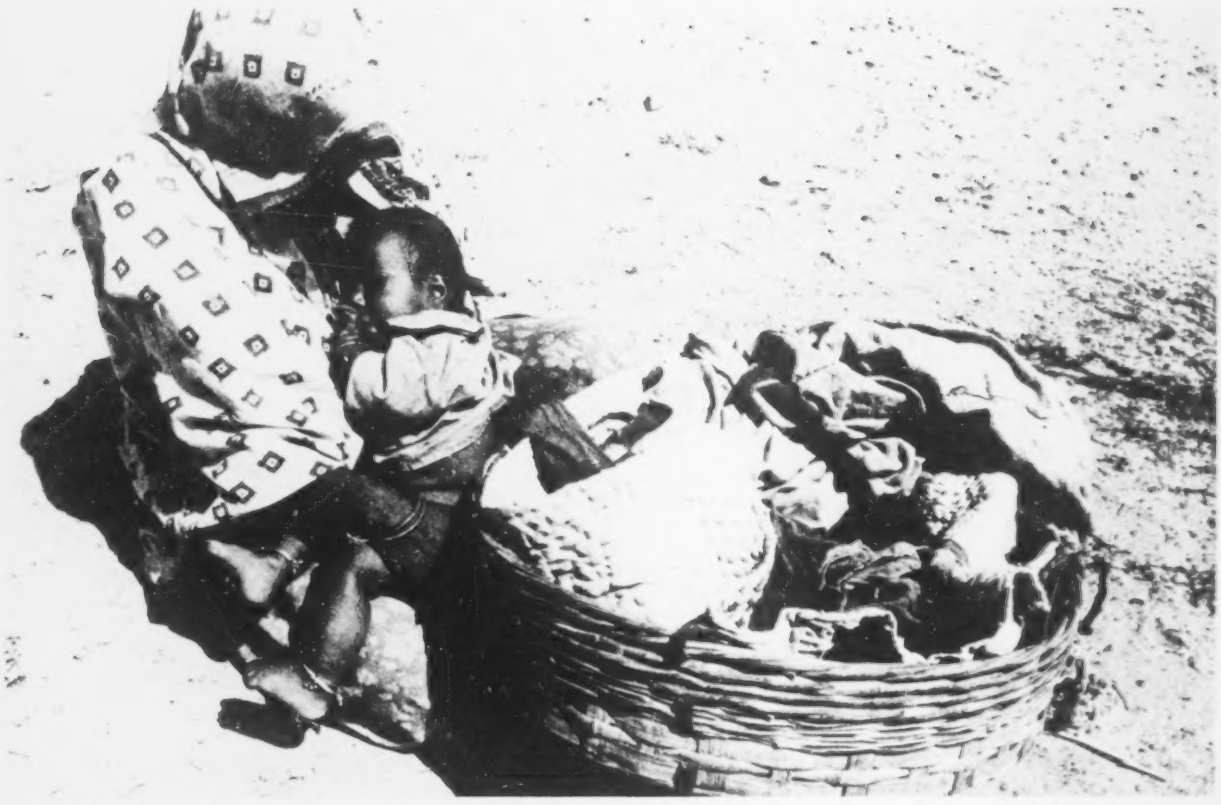
There are a number of immunologically protective agents in human milk, including:

- immunoglobins, which produce antibodies against specific bacteria and viruses (173, 215, 366, 595);
- leukocytes, which destroy bacteria and other foreign substances (173, 386, 396);
- the bifidus factor, which promotes the growth of bifid bacteria, the predominant intestinal flora in breast-fed infants, which in turn prevent the growth of potentially harmful organisms (67, 330, 366, 595).

As a result, breast-fed infants are less likely to develop gastrointestinal disease (109, 144, 495, 610) and viral respiratory infections (109). Breast-fed babies are also less likely to contract middle ear infections (108, 109, 230, 495), either through immunological protection or because holding the infant prone during bottle-feeding allows regurgitated milk to pool in the eustachian tubes, creating a medium for bacterial and viral growth (41, 177, 595). In addition, a number of allergies, including eczema, cow's milk allergy, and allergic rhinitis, are less common among breast-fed infants (367, 397).

Nutrition

An adequate supply of human breast milk satisfies virtually all nutritional needs of an infant for the first four to six months of life (22, 128, 153, 261, 274, 610, 614). After supplementary foods are introduced, breast milk can remain an important source of protein and other nutrients for many months (23, 47, 610, 616).



Breast-feeding provides the best protection against infection and the most nutritious food for the young infant. Breast-feeding also accounts for a substantial amount of child spacing in some countries, but it is not a reliable method of family planning for individual women. (FAO)

NUTRITIONAL NEEDS OF BREAST-FEEDING WOMEN

How much does a woman's diet affect her ability to breast-feed and her child's growth? Can dietary supplements help poorly nourished mothers produce more milk? Surprisingly, research to date has not resolved these questions.

Evaluating the volume and composition of breast milk is exceedingly difficult. No one knows the optimal yield of breast milk for any individual woman (634). The amount produced varies widely, from over 1,000 ml to less than 400 ml, and appears to depend on many different factors, such as birthweight, age, and activity level of the infant, season of the year (277, 431, 583), suckling patterns (255, 569), and even the process of measurement itself (106, 277, 633, 673).

A number of studies worldwide suggest that poor nutritional status diminishes both the volume and probably also the fat and vitamin content of breast milk, although nutritional studies often cannot either record or control adequately all of the factors involved (9, 27, 167, 205, 213, 277, 580, 581, 614, 634, 645, 665, 666). In the Gambia, for example, women who usually produced about 66 grams of milk per feed produced only about 42 grams per feed during the rainy season, a traditional "hungry time" when caloric intake is low and energy expenditure is high because of intense farming activities (431, 583). Also, during the rainy season levels of fat and B-vitamins in breast milk were lower (665). Similar seasonal variations are reported in Zaire and Kenya (227, 678). In Mexico a group of poorly nourished women produced low quantities of milk ranging from less than 400 ml to 650 ml per day (91). What this means for the infant, as Joe D. Wray has pointed out, is that

> a mother producing 500 cc/day of 65-calorie milk, rather than the 800 cc of 75-calorie milk that a well nourished woman can produce, will, in effect, produce 50 percent fewer calories and equivalent deficits of other nutrients. (614)

Nevertheless, it is evident that, except at extremes of starvation or malnutrition, poorly nourished women are able to breast-feed their children and often do so for longer periods of time than women who are better nourished. As Derrick and E. F. Patrice Jelliffe have pointed out,

> The volume and composition of human milk in poorly nourished women is surprisingly good, possibly due to some metabolic adaptations, but probably usually to their cumulative nutritional detriment ("maternal depletion") (277).

An Indian study compared lactating and nonlactating groups, both of which had diets of 1,200-1,600 kcal per day. The lactating women showed a decrease in body weight, arm circumference, and skinfold thickness, indicating that body fat was being utilized to produce milk. Nevertheless, after 12 months, the lactating women weighed only 2 kg less than the nonlactating women (456). This suggests that some process of metabolic adaptation, possibly due to higher prolactin levels, occurs in lactating women, allowing energy balance to be maintained on what would appear to be an inadequate diet (347, 456).

Even so, lactation can impair a poorly nourished woman's health. When nutrition is poor, the mammary glands draw upon maternal body fat and other reserves to produce milk (167, 431). Repeated pregnancies and lactation, often combined with continued hard physical labor, lead to general protein-calorie malnutrition, weight loss, prematurely aged appearance, and various nutritional diseases (455, 632, 651).

Both lactating and pregnant women require more calories, protein, and other nutrients than other women. Nutritional requirements are greater for lactating women than pregnant women because normal infant growth is more rapid than fetal growth, and fewer of the infant's body functions, such as maintenance of body heat, are performed by the mother's body (591). It is not clear, however, if supplementing a lactating woman's diet will increase her milk supply.

Only a few studies have examined the effect of maternal supplementation, and the results are mixed. Milk volume increased with supplementation in four studies (91, 143, 176, 518), but in three other studies there was no change in either milk production or infant weight (114, 176, 460). Methodological problems in many of these studies make interpretation difficult, however. In a Nigerian study, for example, infants' daily weight gain rose significantly—from 30.4 to 45.7 grams—when their mothers received a skimmed milk supplement that doubled the protein content of their diets. The mean volume of milk also rose significantly, although the concentrations of protein, lactose, and milk solids did not change (143). The mothers were hospitalized during the course of the study, however. This reduction in their workload could have allowed additional calories to be used for milk production.

Maternal supplementation programs may show no increase in milk production for several reasons:

- The woman may give the supplement to her children or husband or substitute it for other foods she eats (646).
- The supplement may be insufficient to make up the entire caloric deficit (460).
- Supplementation only after delivery and not during pregnancy may be inadequate (91).

Attention is now focusing on the total energy needs of pregnant and lactating women and the metabolic processes by which poorly nourished women are able to breast-feed for long periods without apparently adequate supplementation. Ideally, lactation depends on fat reserves, about 3.5 to 4 kg accumulated before and during pregnancy (281, 402), as well as on diet during lactation. Undernourished women may gain only 5–7 kg altogether during pregnancy and thus be unable to develop the necessary "fat bank" for adequate milk production (649). For these women, food supplementation might have to begin at least by the last trimester of pregnancy in order to improve breast milk production.

The process of reproduction, including both pregnancy and lactation, places a heavy burden on poorly nourished women that is still not fully measured or understood. Increased recognition of the value of breast-feeding for infant health should therefore be accompanied by increased emphasis on better nutrition and above all on more effective child-spacing for the mother.

Among different mammals, maternal milk appears to be adapted to the offspring's particular needs. The composition of milk varies considerably among mammalian species (208, 389, 640). Furthermore, the composition and quantity of human milk varies among mothers and for each mother from the beginning to the end of each feeding, from feeding to feeding, and over the months of breast-feeding (13, 53, 156, 207, 221, 253, 486, 583, 603, 610). It has been hypothesized that some of these differences correspond to the individual infant's needs (274). There is some evidence that the milk composition in mothers of premature infants differs from that in mothers of full-term infants. This suggests that it may be especially suited to premature infants (4, 28, 29, 44, 194, 497).

No substitute is the nutritional equivalent of human breast milk. Cow's milk, which is the most common replacement for breast milk in Western cultures (274), has a lower proportion of fat and lactose and a higher proportion of protein than human milk (152, 208). It is more difficult to digest than breast milk and more likely to produce constipation (41, 172, 330, 595).

The commercially prepared infant formulas, which are mostly derived from cow's milk, have not yet duplicated the average composition of human breast milk (208, 330, 595). Further, no substitutes can match the differences between feedings and over time.

The Economics of Breast-Feeding

Breast-feeding is usually less expensive than bottle-feeding, but, in calculating relative costs, several comparisons must be considered:

- the direct monetary costs of the breast milk substitute and its preparation compared with the cost of the mother's added nutritional intake, if any,
- the value of time spent on breast-feeding compared with time spent on alternative feeding methods,
- the indirect costs of bottle-feeding—increased infant morbidity and mortality—compared with the indirect costs of breast-feeding—maternal depletion among malnourished women.

In the aggregate, the infant feeding choices made by individual families can have an economic impact on a nation.

Bottle-feeding requires the purchase not only of the breast milk substitute, but also of the bottle and nipple. It requires fuel for sterilization of the equipment and, ideally, refrigeration (47, 190, 274, 330, 372). These costs vary, but generally the cost of proper feeding with a breast milk substitute totals at least $200–$300 (US) for the first year of life (47, 78, 190, 330, 372, 471, 605). Among substitutes, commercial infant formula is generally more expensive than modifying and preparing milk products in the home (47, 190, 372, 446).

Poor families may spend less than $200–$300 a year on bottle-feeding, but the child may suffer as a result. To save money, families may not give enough formula or may overdilute it (526). They may use milk from cows or other animals without modifying it. They may even mix flour and sugar with water so that it simply looks like milk (120). A full estimate of the expense of bottle-feeding should include the cost to the family and to society of resulting increases in infant morbidity and mortality when bottle-feeding is inadequate or improper (47, 190).

The only direct monetary cost of proper breast-feeding is dietary supplementation of the mother before and after delivery (see box, p. J-528). These extra nutritional needs can sometimes be met by additional quantities of inexpensive foods already in the woman's diet, which cost less than bottle-feeding (113, 190, 330, 372). Many women do not or cannot augment their diets while breast-feeding, however, and therefore a full estimate of breast-feeding costs should also include the costs to the family and society of related maternal health problems and, if milk supply is inadequate, child health problems (212).

Even more difficult to assess are the relative time requirements of breast- and bottle-feeding. Breast-feeding is more time-consuming for the mother (3, 136, 404, 442), while bottle-feeding, although it requires much preparation, can be delegated, thus enabling the mother to work outside the home (69, 190, 404, 442). For a woman at the lower end of the wage scale, the cost of infant formula may be about half of her income, resulting in little economic gain (47, 78, 189, 190, 445, 471). For women who can command higher wages, the mother's income, even after subtracting the cost of bottle-feeding, can make a substantial contribution to household income (190, 442). Providing creches, or nurseries, at the work place and allowing nursing breaks during the work day would reduce the personal costs but raise the costs to the employer and to society.

The use of infant formulas may affect national as well as family finances (274, 322). Many breast milk substitutes, particularly commercial infant formulas, are imported and thus must be bought with scarce foreign exchange funds (166, 322). In the past decade the price of importing skim milk powder, for example, has increased sharply—from $300–$400 (US) per ton in 1972 to about $1,500 per ton in 1977 (369). While dried milk is sometimes donated as development assistance, the quantities are small and erratic, since they are related primarily to excess production in the donating country (251).

Para Ibu hendaklah menyusukan anak anaknya selama dua tahun penuh, [illegible] menyempurnakan penyusuan. (Al Baqarah 233).

This Indonesian poster repeats the injunction of the Koran: "Mothers shall nurse their children for two whole years. . . ."

INFANT FOOD SUPPLEMENTATION

Infant food supplementation, or weaning, is the process by which foods other than breast milk are introduced.

Patterns of food supplementation vary widely in different cultures. Supplementary foods are given to infants as early as one to two months or as late as 18 months (3, 23, 73, 128, 199, 227, 303, 351, 355, 380, 384, 395, 466, 513, 577, 605). In a WHO 9-country study on breast-feeding, for example, more than half of the rural Chilean women were regularly supplementing their infants' diets at age two to three months, compared with only 2 percent of the rural Indian women. Among the urban poor Ethiopian women, 12 percent still had not begun food supplementation as late as 18 months postpartum. Types and amounts of food given also varied widely, depending on the products locally available. When infants are offered supplementary food in the first six months, in Zaire the food is generally cereal and legumes; in India, only milk or milk products (605).

When should supplementation start? It has been widely recommended that infants receive only breast milk for four to six months (22, 128, 153, 261, 610). In developed countries, although physicians once routinely recommended very early introduction of solid foods, this practice is now discouraged since the infant's digestive system is then too immature to absorb complex foods. In addition, supplementary foods expose the infant to risk of infection and, if given in large enough amounts, reduce the infant's inclination to suckle at the breast.

In developing countries, however, when the nutrition of the mother is poor, supplementary food may be needed earlier (91, 486, 610). Surveying 17 studies of infant growth in developing countries, J. C. Waterlow and colleagues note that the rates of growth fell off substantially at three to four months or earlier when compared with growth rates of infants from the United Kingdom (571). Henri Vis notes that in central Africa the growth of rural infants begins to falter at two or three months (679). Whether breast-fed infants in developing countries should be following the same growth curves as bottle-fed infants in developed countries is not clear, however, and a slower pattern of growth may be normal for breast-fed infants (234).

Even when the mother's milk supply is ample, supplementation should start no later than six months. Delaying supplementation beyond six months deprives the child of nutrients. In the WHO study, infant weight gain was unusually slow in infants who did not receive any food until after six months (610).

Techniques of supplementary feeding are important. Infants should always be breast-fed before getting solids or formula since breast milk is the more valuable food. The supplementary foods should be given with a cup and spoon, not a bottle. Cups and spoons are easier to clean than bottles and nipples and thus safer for the infant. Moreover, if bottles are used, infants may find them easier than breast-feeding and reject the mother's breast (41, 604). In general, other foods should not replace breast milk, especially for young infants.

Impact on Infant Health

Given the immunological and nutritional benefits of breast-feeding as well as the hazards of substitutes used where they are not appropriate, the practical question is: Does feeding with other preparations, whether commercial or homemade, instead of breast-feeding, have a major impact on infant health and development?

Answers vary, depending on circumstances. On one hand, most studies of small groups living under similar conditions in developed and developing countries tend to show that breast-fed infants experience less illness and lower death rates than bottle-fed infants. On the other hand, the fact that infant mortality is lowest in the developed countries and among the upper socioeconomic groups in developing countries, where bottle-feeding has been most common, suggests that the substitution of bottle for breast has been less important to infant health than other factors such as sanitation, availability of health services, and the education and income of the mother.

The health risks of bottle-feeding compared with breast-feeding are greatest among the urban and rural poor in developing countries, who may not use commercial preparations correctly. For example, poor women may not know how to prepare commercial infant formula; they may not be able to afford an adequate supply; or they may give infants nonnutritious substitutes. Clean water for washing utensils and mixing with formula is often unavailable, as is fuel for boiling the water or sterilizing the bottles, and refrigeration for storage. Under these conditions bacterial contamination is inevitable (526).

Studies of infant feeding and nutrition among several hundred children in Colombia (616), St. Vincents (23), and Lebanon (293) indicate that breast-fed children are less likely to be malnourished than bottle-fed children, or, in the case of Lebanon, that children who fail to thrive are more likely to be bottle-fed, especially in the first three months of life. Moreover, in St. Vincents early weaning from the breast and introduction of supplementary food before four months resulted in less weight gain than delaying supplementation until after four months (23). When supplementation should begin is uncertain, however (see box, this page).

With respect to illness among children, several studies, including some in developed countries (108, 109, 131, 144, 321), find a lower incidence of infection, especially diarrhea, among breast-fed infants (178, 577, 616). In Colombia, for example, Joe D. Wray and Alfredo Aguirre found that only 25 percent of the exclusively breast-fed children had diarrhea during the first five months of life, compared with 54 percent of the partially bottle-fed and 73 percent of the exclusively bottle-fed children (616). Continued breast-feeding during diarrhea is important not only to maintain food and fluid intake but also to prevent cessation of lactation (see **Population Reports**, *Oral Rehydration Therapy for Childhood Diarrhea*, L-2, November-December 1980). Several other studies in developed and developing countries, however, have found no increased risk of disease in bottle-fed children (15, 134, 147). In Malaysia, for example, a study of 250 children reported similar rates of respiratory and gastrointestinal illness among breast- and bottle-fed babies (134).

Infant Mortality

A great deal of public health experience suggests that breast-fed children have lower death rates (306, 461, 573, 613), but only a few studies in developing countries have been specifi-

Breast-feeding can be continued for at least two years with nutritional benefit to the child, but WHO/UNICEF expert groups now recommend that food supplementation begin between four and six months, as this poster from Jamaica suggests. (Ministry of Health)

cally designed to examine mortality and the method of feeding. A study of 1,700 women in rural Chile in 1969 and 1970 found that postneonatal death rates (between the 4th and the 52nd week) were three times higher among infants who started bottle-feeding in the first three months than among those who received only breast milk during that time (440). Because the infants were less likely to be breast-fed, death rates were higher among children whose mothers had moderate education, higher incomes, better sanitation, and prenatal health care than among those without—a contrast with the influence of socioeconomic factors on mortality in most studies.

In a Malaysian study of over 5,500 live-born infants, the risk of dying was significantly greater for infants breast-fed only briefly. The risk of mortality associated with short breast-feeding was substantially less when the infants lived in communities with better water supply and sanitation systems (74).

A recent study in Cairo under the auspices of the International Fertility Research Program found that children who were breast-fed for 15 to 20 months had a 93 percent probability of surviving until the birth of the next child, whereas children never breast-fed or breast-fed for less than three months had a survival probability of about 64 percent (269). Although the educational level of the mother also influenced child survival, the influence of breast-feeding was greater, and the lower the mother's educational level, the more influence breast-feeding had. Among children whose mothers had no education, those breast-fed for 9 to 12 months had a 30 percent higher survival probability than those never breast fed; among children whose mothers had at least seven years of schooling, the difference was 22 percent (269).

This recent evidence is strengthened by historical studies of breast-feeding and infant mortality in Europe and the United States (613). In southern Bavaria in the early part of the 20th century, for example, infant mortality rates were lowest where the proportion of infants breast-fed for at least six months was highest (309).

In the US a cohort study of more than 20,000 infants seen in infant welfare clinics between 1924 and 1929 showed similar results (643). In the first nine months of life bottle-fed babies were over 100 times more likely to die from respiratory disease and over 40 times more likely to die from gastrointestinal disease than breast-fed infants. Mortality rates for partially breast-fed infants were intermediate between the other two groups.

Mortality studies may exaggerate the relative risk of bottle-feeding. Often the deaths of seriously ill infants too weak to suckle or who die before they can breast-feed are counted among the deaths of bottle-feeding infants. In a study in Guatemala, for example, the mortality rates for non-breast-fed infants born between 1969 and 1974 decreased from 386 deaths per 1,000 live births to 208 when infants with health problems preventing breast-feeding were excluded (120). Even when these infants were excluded, however, bottle-fed infants were more than twice as likely to die in infancy as breast-fed infants (120). In a frequently cited study in India, the mortality rate among bottle-fed infants was eight times as high as the rate among breast-fed infants, but half the 20 bottle-fed infants were too weak to breast-feed (178). Research in a society where the reasons for bottle-feeding are not predominantly health problems of the mother or infant would provide a better estimate of the risk of bottle-feeding (120).

While much evidence argues for the importance of breast-feeding in holding down infant mortality rates, in a number of developed countries infant mortality has declined rapidly over the last century even though breast-feeding also has declined. In Sweden, for example, a sharp decline in infant mortality occurred first, followed by a decline in the duration of breast-feeding along with a continued, slower decline in infant mortality (558). This sequence suggests that the trend away from breast-feeding may have slowed, but did not reverse the overall decline in infant mortality. In Thailand infant mortality is lowest in the urban areas and among children of better educated women or urban women with white-collar jobs, who are most likely to stop breast-feeding early (307). As John Knodel and Nibhon Debavalya point out:

> ...although reduced breast-feeding undoubtedly has unfavorable health consequences for children, it does not appear to be a major determinant of infant mortality levels in Thailand. Other factors are apparently more important, including access to modern health services.... Whatever the critical factors are, the fact that infant mortality is at least severalfold higher in the countryside, where prolonged breast-feeding continues to be common, suggests that any significant reduction in the mortality level must stem from improvements in conditions other than breast-feeding practices.... (307)

Nonetheless, a review by the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) concluded that in the future a decline in breast-feeding in developing countries might have a serious adverse impact on child health in areas where health and other social services are inadequate (610).

Other Benefits

A number of other benefits of breast-feeding have been suggested, with varying degrees of proof. These possible benefits for the child include:

- facilitating a close emotional relationship between mother and child (274, 330, 387, 610),
- avoiding dental caries caused by children sleeping with bottles in their mouths (274),
- promoting normal facial development (274, 387),
- avoiding infant obesity (274, 330, 595, 671),
- protecting against various diseases, including coronary heart disease, ulcerative colitis (274, 387), sudden infant death syndrome (196, 274, 595), acute necrotizing enterocolitis, a highly lethal disease of premature infants (595), and multiple sclerosis (129),
- improving speech development (65),
- promoting greater intellectual ability (476, 610).

For the well-nourished woman, breast-feeding helps to restore a slimmer figure by utilizing body fat accumulated during pregnancy and by hastening involution of the uterus. Breast cancer, once thought to be less likely among women who breast-fed, has now been shown to be less likely with a young age at first pregnancy, but not with breast-feeding (350, 654).

Why Women Stop Breast-Feeding

There are few medical contraindications to breast-feeding by adequately nourished women. There are also no known reasons that full-term infants should not breast-feed (330), but some—premature infants or those with serious congenital abnormalities—may be unable to suckle vigorously enough to obtain milk. Nevertheless, despite evidence of the benefits of breast-feeding, some women prefer not to breast-feed, for a variety of physical and psychological reasons. As a recent WHO brochure points out, "The mother who cannot breast-feed or decides not to do so should not be made to feel guilty" (604).

Breast-feeding may cause some illness or discomfort particularly in the early weeks postpartum. Breast engorgement, sore and cracked nipples, and leakage of breast milk are common complaints which sometimes cause women to stop breast-feeding (see p. J-549). A reduction in vaginal secretions due to low estrogen levels may make coitus uncomfortable. Some women therefore use contraceptive foams or jellies to provide vaginal lubrication as well as protection against pregnancy. More serious conditions—breast abcesses and mastitis—are painful but not generally life-threatening. They require medical care and sometimes antibiotics (330). In women with inadequate diets, repeated pregnancies and lactation can lead to maternal depletion (see box, p. J-528).

Women who do not wish to breast-feed may find it physiologically difficult to do so because the release of breast milk to the infant (the "let down," or milk ejection reflex) depends in part on the mother's ability to relax (274).

As many surveys in both developed and developing countries show, one of the major reasons women give for stopping breast-feeding is insufficient milk (200, 274, 291, 482, 605). Why is insufficient milk such a widespread problem? On one hand, experts in the field contend that virtually all women can produce enough milk for their infants (274, 330, 468). On the other hand, there is empirical evidence that some women do have difficulty breast-feeding and that many infants, especially among the poor in developing countries, do not thrive on breast milk alone (9, 38, 91, 176, 213, 571, 614). Insufficient milk is reported in affluent as well as poor communities, however (200). For example, in the WHO Collaborative Study on Breast-feeding, conducted in seven developing and two developed countries, 70 percent of the Hungarian women who had stopped breast-feeding said that they did so because of insufficient milk. In Guatemala 60 percent of the affluent urban women cited insufficient milk compared with 44 percent of the urban poor women and 28 percent of the rural women (605).

The claim of insufficient milk covers a variety of problems ranging from genuine maternal ill health or severe malnutrition to improper feeding techniques, faltering growth or illness on the part of the infant, early introduction of other foods, and lack of confidence, as well as a personal preference not to breast-feed. Some of these problems are poorly understood or cannot be resolved. Often, however, a lack of support and proper information may be the real reasons that women have problems breast-feeding.

In societies where breasts are seen primarily as sexual and erotic, the function of breast-feeding may seem awkward and embarrassing (46, 330), and women may be uncomfortable nursing their infants in public. Women may also be concerned that breast-feeding will change the shape and size of the breasts, although this has not been proven. Leakage of breast milk during sexual intercourse and at other times until the let down reflex is well established may also be disturbing.

Inherent in breast-feeding is the continued heavy reliance of the infant on the mother. The mother's body must continue to provide nutritional support for the infant, as it did during pregnancy. Also, a woman who is fully breast-feeding cannot leave the infant for more than very short periods. Thus breast-feeding limits a woman's ability to move about without bringing the infant along. At the same time, breast-feeding diminishes the opportunities for the father or others to share in feeding the child. These disadvantages become particularly apparent in urban areas where jobs tend to be incompatible with full breast-feeding and where women have opportunities to be active outside the home.

BREAST-FEEDING PATTERNS AND TRENDS

Current research has focused on three different aspects of breast-feeding:

(1) the percentage of infants who breast-feed initially,
(2) the average duration of breast-feeding, and
(3) the type of breast-feeding—described in terms of scheduled or on-demand feeding, with or without night feeding, with or without other foods, frequency of suckling, or intensity of suckling.

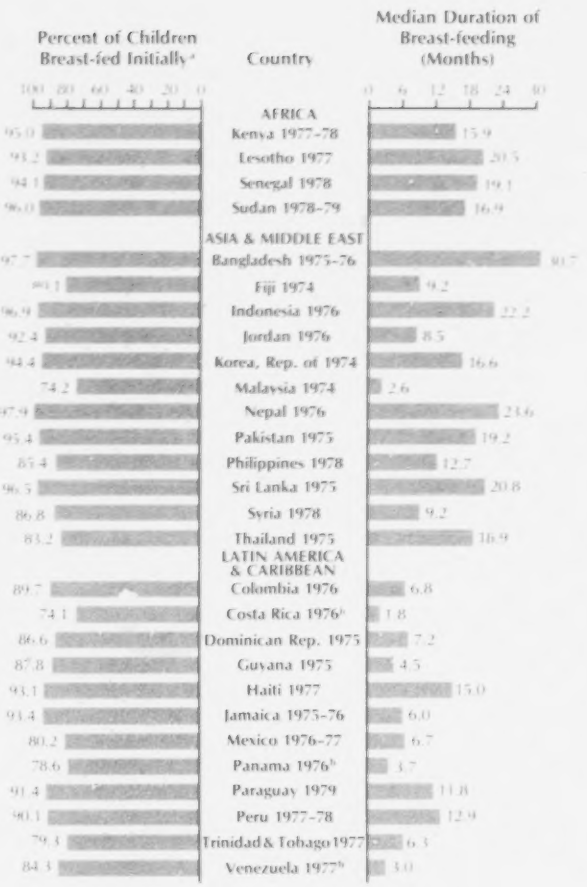
The vast majority of women in developing countries breast-feed their infants initially, although the percentages are slightly higher in Africa and Asia than in Latin America and the Caribbean (see Figure 1). In all 4 African countries and in 7 of 12 Asian and Middle Eastern countries where World Fertility Surveys (WFS) have been taken, more than 90 percent of women whose last child was born within the five years preceding the survey initially breast-fed that child. In 8 of 12 Latin American and Caribbean countries over 85 percent of last children were breast-fed (150). Even in the four countries with the lowest percentage breast-feeding—Malaysia, Costa Rica, Panama, and Trinidad and Tobago—between 70 and 80 percent breast-fed initially.

The recent World Health Organization (WHO) Collaborative Study on Breast-feeding produced similar results, although the various socioeconomic groups studied were not nationally representative. In seven of the nine countries more than 90 percent of the women's youngest infants had been initially breast-fed in all socioeconomic groups. In two of the three participating African countries—Nigeria and Zaire—virtually all infants were breast-fed initially (605).

The duration of breast-feeding is longer in Africa and Asia than in Latin America and the Caribbean (see Figure 1). In the four African countries with WFS data, children are breast-fed for a median of at least 16 months. Among 12 Asian and Middle Eastern countries the median length of breast-feeding ranges from a low of 3 months in Malaysia to a high of 31 months in Bangladesh. In 7 of these 12 countries mothers breast-feed their children on average for 16 months or more. In 12 countries of Latin America and the Caribbean, however, median duration of breast-feeding ranges from 2 months in Costa Rica to 15 months in Haiti (150). These calculations of the length of breast-feeding are based on the ages of children who were being breast-fed at the time their mothers were interviewed (150). Analyses of survey data, like all analyses of breast-feeding patterns and trends, have methodological shortcomings (424) (see box, p. J-538). Nonetheless, these data are the best current indicators of the extent of breast-feeding in these countries.

Another way to measure the duration of breast-feeding is by finding the percentage of women still breast-feeding at designated intervals after delivery—for example, at six months (444). In 9 of 10 Asian and Middle Eastern countries reporting WFS data, 70 percent or more of 6-month-old infants were still being breast-fed (148, 444) (see Figure 2). In Latin America and the Caribbean, however, many have stopped breast-feeding by six months. Among seven of eight Western Hemisphere countries surveyed, the percentage of 6-month-old infants still being breast-fed was between 35 and 60 percent (148) (see Figure 2).

Figure 1. Percentage of Children Breast-Fed Initially and Duration of Breast-Feeding in 28 Developing Countries, World Fertility Survey Data


Percent of Children Breast-fed Initially[a]
Country
Median Duration of Breast-feeding (Months)
100 80 60 40 20 0
0 6 12 18 24 30
AFRICA
Kenya 1977–78 95.0 15.9
Lesotho 1977 93.2 20.5
Senegal 1978 94.1 19.1
Sudan 1978–79 96.0 16.9
ASIA & MIDDLE EAST
Bangladesh 1975–76 97.7 30.7
Fiji 1974 89.1 9.2
Indonesia 1976 96.9 22.2
Jordan 1976 92.4 8.5
Korea, Rep. of 1974 94.4 16.6
Malaysia 1974 74.2 2.6
Nepal 1976 97.9 23.6
Pakistan 1975 95.4 19.2
Philippines 1978 85.4 12.7
Sri Lanka 1975 96.5 20.8
Syria 1978 86.8 9.2
Thailand 1975 83.2 16.9
LATIN AMERICA & CARIBBEAN
Colombia 1976 89.7 6.8
Costa Rica 1976[b] 74.1 1.8
Dominican Rep. 1975 86.6 7.2
Guyana 1975 87.8 4.5
Haiti 1977 93.1 15.0
Jamaica 1975–76 93.4 6.0
Mexico 1976–77 80.2 6.7
Panama 1976[b] 78.6 3.7
Paraguay 1979 91.4 11.8
Peru 1977–78 90.1 12.9
Trinidad & Tobago 1977 79.3 6.3
Venezuela 1977[b] 84.3 3.0

[a]For children born in the five years preceding the survey
[b]Women age 20–49

Source: Ferry & Smith (150)

While the percentage of children initially breast-fed is high in all 28 developing countries reporting World Fertility Survey data (left side of graph), the median duration of breast-feeding varies considerably, ranging from over 30 months in Bangladesh to less than two months in Costa Rica (right side of graph).

Variation in Suckling and Feeding

Breast-feeding can also be measured by suckling frequency, amount of time infants spend suckling, and the extent to which they receive other foods. Since the contraceptive protection of breast-feeding is strongly influenced by the amount of suckling (see pp. J-542–543), it is important to take account of suckling patterns, influences on them, and the ways that they change over time.

The WHO Collaborative Study on Breast-feeding reports a wide variation in suckling patterns in the nine countries examined. During the first six months most mothers who breast-fed did so "on demand," that is, depending on the infant's wants. Feeding on demand, however, ranged from frequent, irregularly timed suckling episodes to feedings approximately every three to four hours. The proportion of women feeding on a schedule rather than on demand was generally higher among urban residents, particularly wealthy ones, than among rural residents (605).

In the first three months of life infants were fed an average of five to seven times during waking hours and two or three times at night. Generally, infants of rural poor women suckled most often, and infants of urban, upper-income women, least often. Among the urban middle- and upper-income groups, the number of daytime feedings dropped steadily as the infants grew older, but among the rural poor most of the 15- to 17-month-old infants still nursing were nursing four or more times during the day (605). Other studies of breast-feeding, especially in rural Africa, report an average of 13 or more feedings per day, including night feedings, for up to 2 years (227, 315). In the WHO study, night feeding of older infants was a common practice in all seven developing countries studied, but in the two developed countries—Hungary and Sweden—most breast-feeding mothers had stopped night feedings by the time the infant was six months old (605).

By three months, more than one-third of the infants in most of the WHO groups had been given supplementary feedings, usually milk and milk-based products, although the variety of foods was wide. By six months, at least two-thirds of the infants

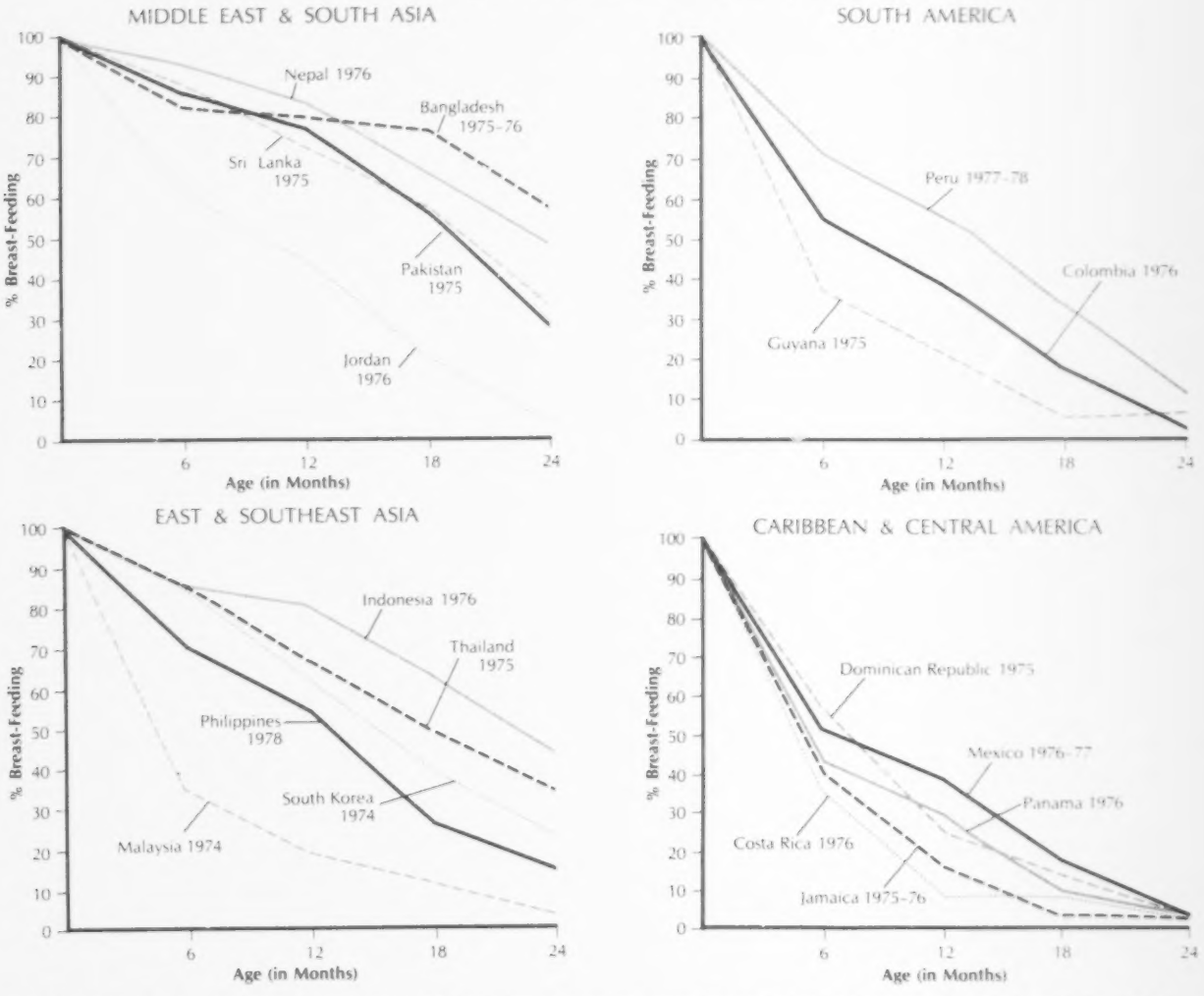
in most study groups received regular supplementation, and by one year supplementary feeding was almost universal (605). Many studies in different countries report that mixed feeding of breast milk and supplementary food beginning in the early weeks postpartum is a common practice (3, 23, 73, 128, 199, 227, 303, 351, 355, 380, 384, 395, 466, 513, 577). By contrast, in some areas, such as rural India, children are exclusively breast-fed well beyond six months (354, 605), when, it is generally agreed, supplementation should begin (see box, p. J-530).

Breast-Feeding Trends

An increasing amount of evidence suggests that fewer women in the developing world now initiate breast-feeding and those who breast-feed continue for shorter periods. This has caused growing concern among health professionals (32, 47, 89, 189, 274, 405, 435, 446). Concern about breast-feeding trends is not new. Medical writers for centuries have noted the importance of breast-feeding to infant health and have lamented the failure of upper-class women to breast-feed their own children (587). The use of wet nurses was common among the upper classes in ancient Greece and later in Europe long before commercially manufactured infant formulas became available (586). At about the time of the industrial revolution in the 19th century, breast-feeding began to decline among women of all classes in the European countries (588, 589).

In the last three decades, the practice of breast-feeding seems to be declining in many developing countries throughout the world. The best statistical evidence of declines comes from five countries where samples representative of the national population have been studied—South Korea (101), Thailand (307), Malaysia (73), Taiwan (382), and Mexico (380). In Thailand,

Figure 2. Percentage of Women Initiating Breast-Feeding Who Continue to Breast-Feed, by Infant's Age, in Developing Countries, World Fertility Survey Data



Note: Plotted points are based on the sums of numerators and denominators for the month preceding and the month following as well as for the indicated month. For example, the percentage plotted at six months is based on data for five, six and seven months.

Source: Ferry (148)

The duration of breast-feeding can be measured by the percentage of women initially breast-feeding who are continuing to breast-feed at specified intervals after delivery. At 12 months, more than half of these women are still breast-feeding in 8 of 10 Asian and Middle Eastern countries (graphs on left) but in only one of 8 Latin American and Caribbean countries (graphs on right).

Taiwan, and Mexico, several consecutive surveys were taken, thus minimizing memory errors. In Malaysia and South Korea, information came from personal life histories.

In South Korea the practice of prolonged breast-feeding—for at least 18 months—declined sharply between 1950 and 1970, from over 55 to about 35 percent of first births. There was only a slight decrease, however, in the percentage of first-born infants breast-fed at least one year, which remained above 75 (101).

In Thailand between 1969 and 1979 the average duration of breast-feeding declined by almost five months—from 12.9 to 8.4 months in the cities and from 22.4 to 17.5 months in rural areas. As in South Korea, there appears to have been little change in the proportion breast-feeding initially (307).

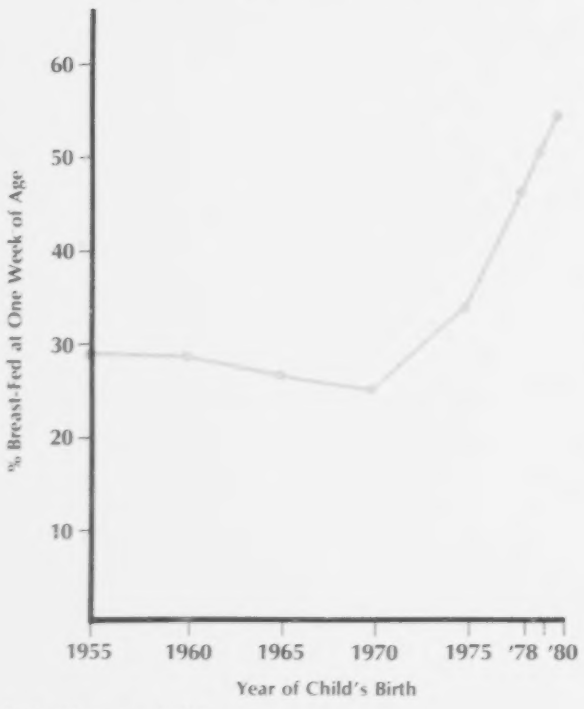
In Malaysia, on the other hand, from before 1960 to 1974 there was a drop both in the percentage breast-feeding initially and the duration of breast-feeding. The percentage of infants breast-fed initially dropped from 89 to 74 percent and the percentage breast-fed for more than three months decreased from 75 to 53 percent. The changes have been greater among ethnic Indians and Chinese than among ethnic Malays. There has also been a decline in the age at which supplementary foods are introduced (73).

In Taiwan also, the percentage of infants initially breast-fed fell sharply, from 93 in 1966 to 50 in 1980. During the same period the average duration of breast-feeding of children ever breast-fed dropped from 14.6 months to 8.8 months (382).

In Latin America national breast-feeding trends over long periods of time are not available. In Mexico the percentage of last liveborn infants initially breast-fed dipped from 80 to 78 percent in the 3-year period 1973 to 1976 (380). Whether this decline will continue is not clear. Recent Contraceptive Prevalence Surveys in other Latin American countries, however, suggest that breast-feeding has declined substantially. Less than 5 percent of the women surveyed in the cities of São Paulo (Brazil), Panama City (Panama), and San Salvador (El Salvador) breast-fed for six months or more, and in the state of São Paulo, Brazil, less than 50 percent breast-fed for as long as one month (392).

Other evidence of declines in breast-feeding comes from community health studies, repeated but not always comparable surveys, review of data from specific health care centers, and the clinical impressions of people with long experience in child health programs in developing countries. While this information may be questionable from an epidemiological point of view, it all points toward a considerable decline in breast-feeding, especially in urban areas. For example, among upper- and lower-income ethnic Chinese in Singapore, in 1951, 85 and 90 percent of infants, respectively, were initially breast-fed; in 1971, 28 and 51 percent were breast-fed. While in 1951 some 45 percent of infants among the poor and 77 percent among the wealthy were still breast-fed at three months, by 1971 about 5 percent in either group were (681). Among the Baganda people of Uganda the proportion of infants attending child welfare clinics who received supplementary bottle-feeding before six months of age rose from 14 to 30 percent between 1950 and 1955, although the duration of lactation did not change (577). According to surveys of outpatient clients in southern Brazil, in 1940 some 98 percent of infants were initially breast-fed; in 1974, 76 percent. During the same period the percentage still fully breast-fed at six months fell from 68 to

Figure 3. Percentage of Infants Breast-Fed at One Week of Age, United States, 1955–1980



Source: Martinez et al. (360)

In the US, the percentage of infants being breast-fed at one week of age is rising sharply after declining for several decades. Increases in initial breast-feeding are also reported in Sweden and Australia.

12 (670). Studies of groups as varied as Micronesian villagers (357) and Canadian Eskimos (495) found that the more recently a child was born, the more likely the child was to be partially or entirely bottle-fed.

By contrast, in some developed countries the practice of breast-feeding is now increasing after several decades of decline. In the United States the percentage initially breast-feeding has been rising since the early 1970s. After declining to 22 percent in 1972 in one set of surveys, it rose to 34 in 1975 (225, 233). In another set of surveys, the percentage initially breast-feeding declined to 25 percent in 1970, rose to 33 percent in 1975, and to 54 percent in 1980 (360) (see Figure 3). The latter surveys show that between the years 1955 and 1980, while the percentage initially breast-feeding dropped and then rose, the percentage initially receiving infant formulas rose steadily, and the percentage receiving evaporated milk and cow's milk dropped dramatically (360). Concerning the duration of lactation, in 1971 only 5 percent of infants were still being breast-fed at ages five and six months; in 1980, 25 percent (360, 361).

Increases in breast-feeding have been reported in other developed areas as well. For example, in Sweden official statistics show that between 1972 and 1975 the percentage of infants fully breast-fed at two months of age rose from 31 to 46 percent; at six months of age, from 6 to 14 percent (235, 558). At infant welfare centers in Victoria, Australia, the percentage of infants breast-fed at three months rose from about 20 in 1972 to 38 in 1977 (515, 593). In a suburb of Sidney, Australia,

the percentage breast-feeding at six months rose from 12 in 1972 to 48 in 1977 (332).

Sociodemographic Factors

Breast-feeding patterns in developing and developed countries may be influenced by many sociodemographic factors, including:

- place of residence—rural or urban
- education and socioeconomic status of the parents
- mother's age and parity
- support from family and friends
- employment of the mother
- use of contraception.

Many of these sociodemographic factors are closely related, making analysis difficult. For example, the urban woman is more likely to be well-educated, employed, relatively isolated from her extended family, younger, and with fewer children. Therefore, as a study looks at one factor, it must take others into account; this can be done statistically. Even more difficult is identifying and accounting for a large number of possible influencing factors. For example, in an 8-country study the seven common sociodemographic factors studied together explained only between 6 and 32 percent of the variation in breast-feeding duration (265) (see Table 1).

Of the factors studied to date, urban-rural residence seems to have the most consistent effect. In all developing countries for which data are available, rural women are more likely to breast-feed than urban women (19, 73, 132, 265, 284, 301, 307, 380, 444, 505, 524, 557, 567, 577, 605). While urban-rural differences are pervasive, they are not always large, particularly in Africa (444, 605). According to WFS data, in many countries the difference in the proportions that breast feed initially is slight, but urban women breast-feed for markedly shorter periods. For example, among rural infants, more than half were still breast-feeding at six months in seven of eight Latin American and Caribbean countries, while among urban infants in only one country—Peru—were more than half still breast-feeding at six months (444). In Thailand, Jordan, and Pakistan studies have found that women who had always lived in rural areas breast-fed the longest; women who had always lived in urban areas breast-fed the shortest; and those who had moved from rural to urban areas breast-fed for an intermediate period (307, 505, 628). In Thailand, Jordan, and Taiwan breast-feeding was more likely in smaller cities than in larger cities and more likely in rural areas that were farther from urban centers (307, 382, 628). In the three Asian countries for which nationally representative data on urban-rural trends are available, breast-feeding duration has declined in both urban and rural areas (73, 307, 382).

In developing countries, the better educated a women and the higher her socioeconomic status, the less likely she is to start breast-feeding, and, if she starts, on average she breast-feeds for a shorter period. This pattern has been seen in about two dozen countries (19, 30, 132, 284, 301, 380, 382, 395, 406, 423, 442, 577, 605). The associations seen between residence, education, and socioeconomic status, on one hand, and the extent of breast-feeding, on the other, cannot be proved to be causal from these studies (70). Nonetheless, the associations suggest that, as urbanization, education, and standard of living increase, the overall practice of breast-feeding will decline unless other changes counteract them.

By contrast, in some developed countries, including the US and Sweden, breast-feeding is now more common among

Table 1. Association of Selected Sociodemographic Factors with Duration of Breast-Feeding for the Next-to-Last Child, World Fertility Survey Data for Eight Countries

+ = statistically significant positive association
0 = no association
– = statistically significant negative association

	Bangladesh	Indonesia	Jordan	Sri Lanka	Colombia	Guyana	Panama	Peru
Older age	+	+	+	0	+	0	0	+
Higher parity	–	–	0	0	0	0	0	0
Better educated mother	–	–	–	–	–	–	–	–
Urban residence	–	–	–	–	–	–	–	–
Male child	0	0	0	0	0	0	0	0
Mother employed since marriage	0	0	0	0	0	0	–	0
Death of breast-feeding infant	–	–	–	–	–	–	–	–
% of variation explained by these variables	5.7	31.6	12.3	12.2	13.7	5.9	13.3	26.2

Source: Jain & Bongaarts (265)

highly educated women (104, 233, 235, 360, 512, 514, 605). In the US, college-educated women are most likely to start breast-feeding and to breast-feed for longer durations; women who attended no more than high school are least likely to breast-feed; and women with still less education are between the other two groups (233).

Once other factors are taken into account, there is no consistent relationship among countries between a mother's age or the number of previous children and the likelihood that she will breast-feed. In some countries older women are more likely to breast-feed, and for longer durations, but this is not always the case (19, 73, 148, 225, 233, 265, 301, 380, 512, 605). Individual women often seem to follow the same breast-feeding pattern for each of their children. Thus, if a mother breast-fed a previous child, particularly if she breast-fed for a relatively long time, she is much more likely to breast-feed her current infant for a long time (97, 138, 233, 579, 605). Despite the apparently widespread preference for sons, boys generally are not breast-fed longer (19, 148, 265, 382, 403). In South Korea and Jordan, however, boys are somewhat more likely to be breast-fed initially (403, 628).

A woman's family situation and friends influence both her ability and her desire to breast-feed (3, 19, 73, 272, 274, 285, 364, 382, 442, 468, 528, 557, 610). Women who have breast-fed provide the new mother with models to emulate and advise her how to breast-feed successfully. Members of the household may help a woman breast-feed soon after childbirth by doing household chores or by earning an income for the

family. Several studies have shown that, when older children, adult relatives, or servants are present, women are more likely to breast-feed initially and, in some cases, longer (19, 73, 382, 442). Their presence, however, can also lead to earlier supplementation and an earlier end to breast-feeding (73, 442, 557), suggesting that they may also help with supplementary feeding.

Influence of Employment

Does a woman's employment affect her breast-feeding? Logically, the location of the woman's workplace and her child care arrangements cannot fail to affect her opportunities to breast-feed. Nonetheless, evidence on the link between working and breast-feeding practice is not clear (19, 233, 279, 307, 442, 443, 445, 557, 561). The fact that women in surveys do not often cite "employment" as a reason for not breast-feeding (561) should not be considered conclusive, since women also rarely mention urban residence, advertising, or the advice of friends or health personnel as reasons for not breast-feeding (70).

Often the results of studies depend on how work is defined and where it is performed. In an analysis of WFS data from eight countries, whether a woman worked and where she worked were generally not associated with breast-feeding duration, but "work" included any work since marriage and appeared to have been interpreted differently in different countries (265). Further analysis of data for two of these countries—Jordan and Sri Lanka—shows, however, that women who worked outside the home when their children were young were less likely to breast-feed (19, 628). In Taiwan women employed outside the home were less likely to breast-feed than either housewives or women who worked at home for pay (382). In Malaysia women who work for wages are less likely to breast-feed, and those who earn the highest wages breast-feed the least (73). In Thailand breast-feeding does not seem to be much influenced by a woman's place of work, employer, or whether she receives wages, but, among those employed, white-collar workers breast-feed the least (307). In the US, occupation does not seem to have a strong influence on breast-feeding (233). Overall, agricultural employment, which is the usual role for women in traditional societies, is more likely to be associated with prolonged breast-feeding than any other type of employment or remaining home without other work (73, 307).

Contraceptive Use

In general, women who use modern contraceptives are less likely to breast-feed than women who do not use modern contraceptives (19, 73, 307, 340, 382, 505, 626, 625, 628). Furthermore, when contraceptive users do breast-feed, the duration of breast-feeding is likely to be several months shorter. Where different contraceptive methods have been compared, women who use oral contraceptives are less likely to breast-feed or

Agricultural work is not incompatible with breast-feeding, and in some parts of Africa women breast-feed for up to three years.

Urban women who work outside the home or in white-collar or well paid jobs are less likely to breast-feed than rural women. (ILO)

PROBLEMS IN STUDYING BREAST-FEEDING PATTERNS

Breast-feeding depends on the interaction of personal motivation and the physiology of lactation—both complex processes that are not fully understood. Thus many methodological problems arise in studying breast-feeding behavior by surveys. These problems include:

- Some surveys study large, randomly selected groups but often without sufficient detail, while more detailed studies of smaller groups are often not representative of the whole population.
- A complete description of breast-feeding requires information on the frequency and duration of infant suckling and on the frequency and types of supplementary foods provided. This information is difficult to gather in surveys.
- When data are gathered retrospectively, women may make errors or give round numbers when recalling breast-feeding experience. For example, women often report breast-feeding duration as a multiple of six months, but other evidence suggests that cessation of breast-feeding is usually more gradual (148, 163, 307, 406, 340).
- Most women know that breast-feeding is better for the infant than bottle-feeding (605) and so may report breast-feeding that did not take place because they think that interviewers favor breast-feeding (270).
- Analyses of survey data may yield very different results depending on whether only last births, only next-to-last births, or all births within a given number of years are considered. For example, the choice of which births to analyze makes a 6-month difference in the estimated duration of breast-feeding calculated from World Fertility Survey data for Pakistan (426).
- Whether infants who die are included in the analysis affects the results, particularly if there is a high infant mortality rate.

Because of these problems, much of the survey research to date has been incomplete, biased, or inconclusive (102, 202, 203, 339, 424, 426, 516). Although certain overall patterns are evident, many conclusions are still tentative and country-specific.

Key to Figure 4

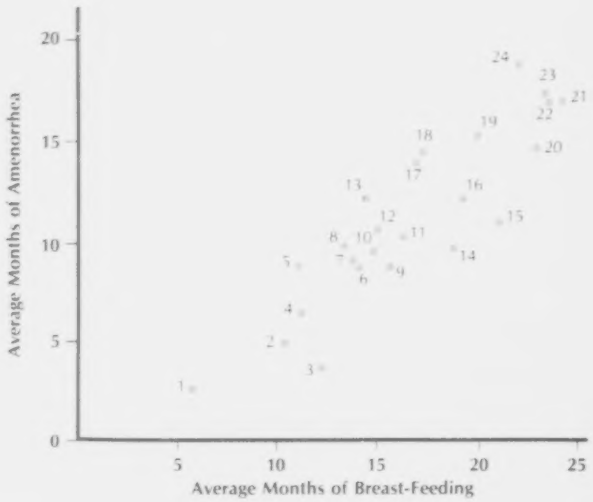
No.	Population & Ref. No.	No.	Population & Ref. No.
1	urban Nigeria—women with secondary education (340)	11	US—self-selected (304)
2	urban Nigeria—women with primary education (340)	12	Taiwan—national sample (268)
3	urban Iran (508)	13	Ghana—national sample (163)
4	India—university clinic patients (619)	14	urban Senegal (149)
5	rural Philippines—IUD acceptors (421)	15	rural India (450)
6	rural Yemen (399)	16	urban Senegal (149)
7	rural Nigeria—next-to-last births (576)	17	rural Guatemala (118)
8	rural Nigeria—last births (576)	18	rural Zaire (86)
9	urban Nigeria—women with no education (340)	19	semiurban Senegal (149)
10	urban Zaire (86)	20	US—self-selected, feeding on demand (304)
		21	rural Bangladesh (94)
		22	rural Togo (343)
		23	rural Senegal (149)
		24	rural Zaire (86)

breast-feed for a shorter period than women using other methods (307, 420, 625, 653).

Because breast-feeding depends on both deliberate choices and physiological reactions, it is often not clear from information available in surveys exactly what determines the duration of breast-feeding. One possibility is that women who use modern contraception, like those who curtail breast-feeding, tend to be predominantly urban, better educated, and from middle- or upper-income groups (see **Population Reports,** *The World Fertility Survey*, M-3, July 1979, and **Population Reports,** *Contraceptive Prevalence Surveys: A New Source of Family Planning Data*, M-5, May-June 1981.) Their socioeconomic situations may independently influence both breast-feeding and contraceptive use. Another possibility is that women who breast-feed for shorter periods need to adopt effective contraception earlier in order to assure a reasonable interval between pregnancies. Still others may be substituting the more certain protection against pregnancy that modern contraceptives provide for the traditional protection of breast-feeding (307, 625), which grows increasingly unreliable as breast-feeding continues (see pp. J-539-541).

Still, there are exceptions. In Thailand and South Korea contraceptive users who want no more children breast-feed longer than users who want more children (307, 403). These women apparently welcome the double protection of breast-feeding and contraceptives. Also, some women may use contraceptives to be sure that breast-feeding is not interrupted by another pregnancy. In the Philippines, for example, IUD users have lower pregnancy rates and breast-feed longer than women who use other methods or who use no method (420, 422). In Ghana IUD users have the longest birth intervals and breast-feed the longest, and users of hormonal contraceptives also have longer birth intervals and breast-feed longer than women who use no contraception, although not as long as IUD users (653).

Figure 4. Average Durations of Breast-Feeding and Amenorrhea for Various Populations



When various groups are compared, it is clear that the longer the average length of breast-feeding, the longer the average length of amenorrhea. When breast-feeding is prolonged, menses tend to resume before the end of breast-feeding.

Survey data from Thailand (307), Ghana (653), Lebanon (482, 625, 626), and the Philippines (420) show that oral contraceptive users breast-feed for several months less than women who use IUDs or other contraceptive methods. This may mean that the hormones in oral contraceptives have a physiological effect in reducing lactation, as some clinical studies suggest (see pp. J-545–546). Alternatively, it may mean that women who are ready to stop breast-feeding prefer a highly effective method of avoiding pregnancy. Other possibilities are that program policies discourage the distribution of pills to breast-feeding women, which forces women who want the pill to stop breast-feeding (479, 481), or that women are concerned that oral contraceptives may adversely affect the infant and therefore stop breast-feeding when they start to use the pill. Again, on the basis of the available evidence, it is difficult to distinguish the effects of physiological changes from deliberate decisions about breast-feeding and contraceptive use.

Overall, fertility is lowest where contraceptive use is highest (392, 416). Where fertility is high and contraceptive usage low, however, breast-feeding is the principal factor that determines the birth interval length (55). In these areas a major reason for stopping breast-feeding is not the use of contraception but rather another pregnancy (30, 105, 167, 170, 201, 242, 274, 291, 336, 406, 407, 482, 529, 530, 605). Thus contraception can either substitute for or prolong breast-feeding, depending on individual circumstances and motivation.

IMPACT OF BREAST-FEEDING ON FERTILITY

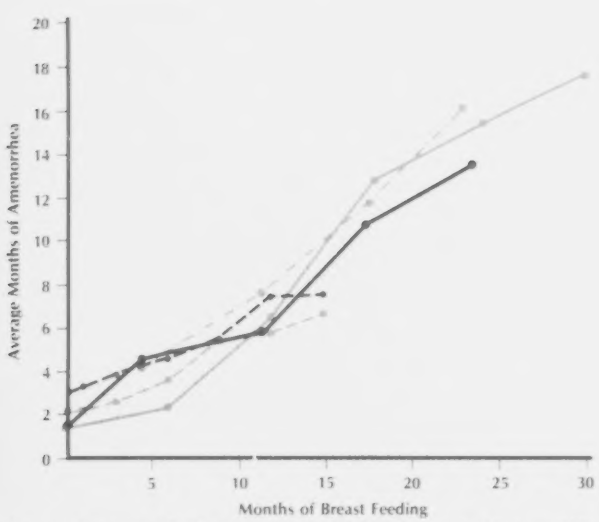
Breast-feeding delays menstruation, inhibits ovulation, and therefore reduces the likelihood of conception. In general, the longer a woman breast-feeds, the longer she will remain infecund. Although the contraceptive effect of lactation has been recognized by various cultures for centuries—at least since the ancient Egyptians (647)—only during the last few decades have biological scientists and demographers focused attention specifically on the length, variations, implications, and causes of lactational infecundity. The overall conclusion is that breast-feeding makes a substantial contribution to birth spacing and fertility control in many areas (668), but that for an individual woman it is an unreliable method of family planning.

Recent research has looked in detail at the relationships between breast-feeding and

- resumption of menstruation,
- resumption of ovulation,
- birth intervals or subsequent pregnancy.

Studies from many parts of the world show a positive relationship between the duration of breast-feeding and the length of postpartum amenorrhea, as illustrated in Figures 4 and 5. Figure 4 compares average duration of breast-feeding and average duration of amenorrhea in different groups of women. For example, urban Nigerian women with primary education (point 2) and clients at an Indian university clinic (point 3) breast-feed for an average of about 11 months and experience amenorrhea averaging 5 and 6 months, respectively. In rural Senegal, where breast-feeding averages over 23 months, amenorrhea lasts almost 18 months (point 23). The relationship is least consistent among groups where breast-feeding is either relatively short—12 months or less—or relatively long—over 20 months. In the intermediate range, however, each additional month of breast-feeding means an average of almost one additional month of amenorrhea (72, 267, 268, 339, 433, 434, 564). Figure 5 shows the length of amenorrhea for women within populations according to the length of time

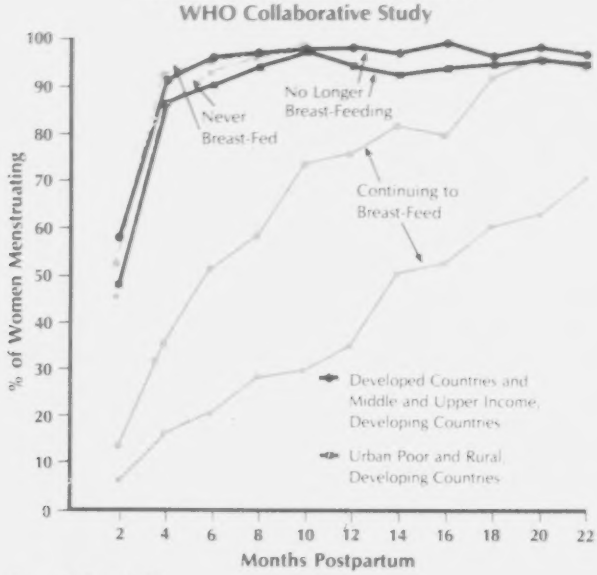
Figure 5. Average Duration of Amenorrhea by Duration of Breast-Feeding in Selected Populations



Sources: Bongaarts (55), Cantrelle & Ferry (83), Cantrelle et al. (84), Sivin (510)

Within a group of women, those who breast-feed for a shorter period experience shorter amenorrhea. In the groups shown, each represented by a line, women who do not breast-feed at all experience amenorrhea lasting one to three months, while for women who breast-feed about 18 months, it lasts 8 to 13 months.

Figure 6. Percentage of Women Menstruating by Months Postpartum According to Breast-Feeding Status, WHO Collaborative Study



Source: Billewicz (51)

Among women who breast-feed, the percentage who have resumed menstruating increases gradually with time since delivery (solid red lines). Among women who stop breast-feeding (black lines) or who never breast-feed (dashed red lines), almost all menstruate immediately if they are four or more months postpartum.

Insuring adequate milk production and also delaying the return of fertility depend primarily on how often and how long the infant suckles and very little on the mother's age, parity, or nutrition. (WHO/J. Mohr)

each woman breast-feeds. The longer a woman breast-feeds, the longer her amenorrhea lasts. For example, while women in these populations who do not breast-feed at all will average one to three months of amenorrhea, women who breast-feed for 18 months will experience amenorrhea lasting 8 to 13 months.

This relationship can be examined in more detail by comparing breast-feeding women, women who once breast-fed but have stopped, and women who have never breast-fed. At a specified number of months postpartum, what percentage of each group will have resumed menstruation? Figure 6, based on data from the WHO 9-country study, shows that by four months postpartum almost all women who are not breast-feeding are menstruating, whether they ever breast-fed or not. For women who continue to breast-feed, menstruation resumes much more slowly (51).

As Figures 4, 5, and 6 all show, there is considerable variation in these relationships among different groups of women. Some of the variation in Figures 4, 5, and 6 is the result of differences in study methodology (57, 219, 362, 424), but some is the result of actual differences in the groups studied. For example, in Figure 6, using data from the same study, at the same time postpartum a much higher percentage of the urban poor and rural developing country women remain amenorrheic than of the more affluent developing country women and the developed country women (51). The cause of this variation is still being researched and debated but is generally thought to be due to different patterns of suckling (see p. J-542).

Ovulation and Infecundity During Breast-Feeding

The start of ovulation among breast-feeding women is obviously much more difficult to measure than the start of menstruation. Accurate methods of detecting ovulation are tedious or expensive, while simpler methods are inaccurate. Thus, studies on resumption of ovulation are few and small, with widely varying results. They focus on ascertaining how often ovulation precedes menstruation and under what conditions. This is a matter of practical concern to family planning programs because, when ovulation takes place before menstruation, women may be at risk of becoming pregnant again before they realize they are fecund and so start contraception.

In eight studies the percentage of breast-feeding women identified as ovulating before first menses ranged from 12 to 78 percent (107, 111, 433, 434, 459, 655, 674, 675, 677). In general, the longer the time since delivery, the more likely ovulation is to precede menstruation (434, 638). For example, in a Chilean study by Alfredo Perez and colleagues, ovulation before first menses occurred in 84 percent when menses resumed 60 or more days postpartum compared with 52 percent when it resumed between 30 and 59 days postpartum. Breast-feeding status made a difference, however. Whether menses resumed 30–59 days or 60 days or more postpartum, ovulation before first menses was most likely in non-breast-feeding women, intermediate in partially breast-feeding women, and least likely in fully breast-feeding women (434).

Another way to measure how frequently ovulation precedes menstruation is to identify pregnancies that occur during amenorrhea. In the groups surveyed by the WHO Collaborative Study on Breast-feeding, one to 11 percent of the pregnant women said that they had conceived during amenorrhea (605). In other, prospective studies, between none and 19 percent of women conceived during postpartum amenorrhea, with most studies reporting between one and 10 percent (49, 61, 94, 146, 220, 242, 266, 292, 304, 433, 434, 459, 489, 536, 564, 617). Some of the women were using contraceptives; without contraception, the percentages might have been higher. In groups with little or no contraceptive use, from 3 to 9 percent of women are reported to have become pregnant during postpartum amenorrhea (94, 266, 536).

Even after first menses, some breast-feeding women do not ovulate regularly in the early cycles. In a prospective study of an average of three early cycles after first menses in 134 Chilean women, 43 percent of cycles were apparently anovulatory in the fully breast-feeding women compared with 14 percent in partially breast-feeding women and 9 percent in non-breast-feeding women (663). In a study in Zaire 80 percent of 56 breast-feeding, menstruating women did not ovulate in the cycle studied, compared with 39 percent of 56 non-breast-feeding, regularly menstruating women (123). Other evidence that early cycles after first menses may be anovulatory is that a high proportion of cycles are irregular (49, 508).

Even in early cycles that are ovulatory, whether before or after first menses, a woman may be at less risk of pregnancy than later. Necessary physiologic processes other than ovulation, such as development of the endometrium or the corpus luteum, may not yet be adequate to sustain pregnancy (192, 376, 434, 536, 674).

Whether because of anovulatory cycles or other irregularities in reproductive functioning, lower fecundity after first menses among breast-feeding women is suggested by a comparison of pregnancy rates among noncontracepting Alaskan Eskimos. Twelve months after the first postpartum menses, the life-table pregnancy rate was 60 among breast-feeding women and 81 among non-breast-feeding women (49). Similarly, among noncontracepting women in Taiwan, the likelihood of pregnancy within 12 months after menstruation resumed was 68 percent

for those who continued to breast-feed and 80 percent for those who stopped breast-feeding before menstruation resumed (266).

Effects of Shorter Breast-Feeding on Fertility

Because the length of breast-feeding and the length of postpartum infecundity are linked, any substantial shortening of the average duration of breast-feeding will lead to higher fertility unless contraceptive use increases fast enough to counteract this effect. A number of studies have shown that shorter breast-feeding durations mean shorter intervals between births and thus a larger completed family size (85, 94, 265, 341, 358, 458). Figure 7 shows a number of possible patterns of birth intervals and fertility, including prolonged breast-feeding without contraception, shorter breast-feeding without contraception, and breast-feeding with contraception.

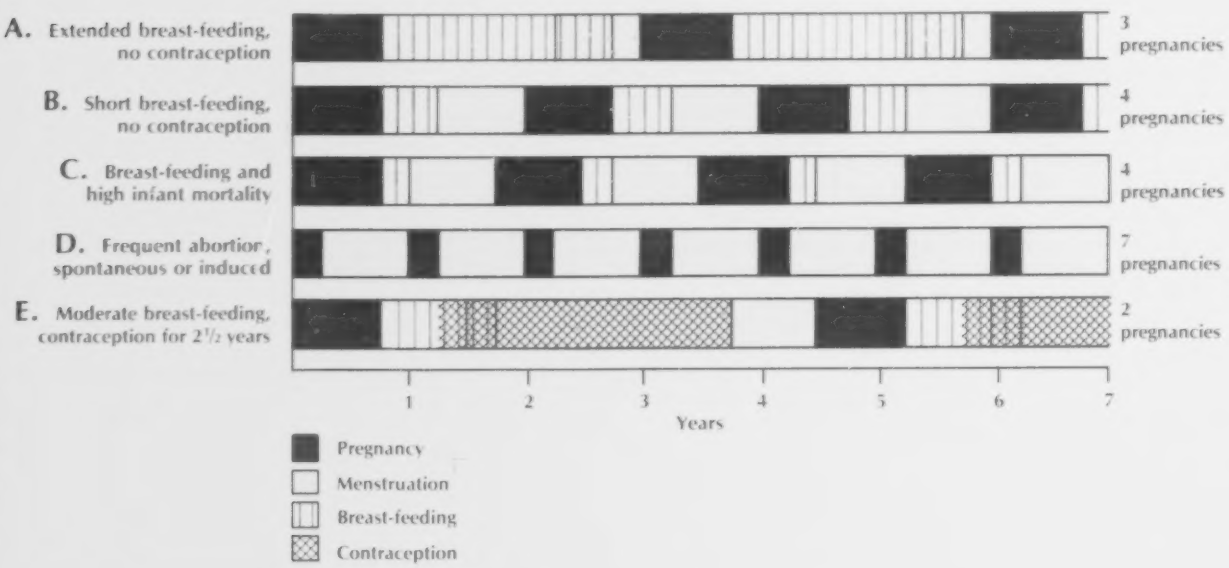
Changing patterns of postpartum abstinence can also make a difference in fertility. The practice of postpartum abstinence in some cultures, mostly in sub-Saharan Africa, adds to the birth interval when it extends longer than postpartum infecundity (338). Abstinence prolonged beyond the return of fecundity often is related to extended breast-feeding. Young, educated, urban women in these cultures seem generally to be breast-feeding less and abstaining for shorter periods, both of which might be expected to increase fertility (76, 132, 163, 247, 249, 338, 349, 388, 406, 419, 491, 499).

In some population groups, especially in urban areas where women are exposed to modernizing influences, fertility may already be increasing, largely because of declines in breast-feeding without compensating increases in the use of contraception (400). Such increases—usually suggested by decreasing birth intervals over time or shorter birth intervals among more "modern" groups—have been observed in Pakistan (95, 426, 505), Senegal (149), South Korea (101), Zaire (86, 477, 488), and among ethnic Indians in Malaysia (112), the !Kung people in Botswana (334, 335, 336), the Yoruba in Nigeria (76, 340, 388, 419), Indians in Canada (478, 495), and elsewhere.

Currently, these fertility increases are the exception rather than the rule. In most areas with available data, increasing contraceptive use has more than compensated for declining breast-feeding, and fertility rates are falling. Increasing contraceptive use and declining fertility are seen in Taiwan, Thailand, and South Korea, for example, where breast-feeding duration has dropped considerably (300, 392). Also, while shorter birth intervals due to shorter breast-feeding have been most notable in urban areas, on the whole urban women have the lowest fertility rates because of more extensive contraceptive use, even though they breast-feed the least (300, 341, 392). Thus, any increases in fertility are thought to be only temporary (16, 417, 477), as was the case in South Korea (101).

Experience in Malaysia illustrates the interaction of breast-feeding and contraception and their differing net effect on birth intervals. Among the Chinese and Malay ethnic groups, women of low parity are breast-feeding less but using contraception more. The result is that birth intervals have changed little. Among Chinese and Malay women of higher parity, increasing contraceptive use is more than compensating for declining breast-feeding, and birth intervals are growing longer. Among the Indian ethnic group, however, women of low parity are breast-feeding less, but few are using contraception. As a result, birth intervals are growing shorter and fertility is rising. An adverse health impact can also be seen: birth weights are dropping and infant mortality is rising (74, 112).

Figure 7. Patterns of Breast-Feeding and Contraception: Effects on Fertility



These bars illustrate different patterns of breast-feeding and contraception and their impact on fertility. Model A depicts a traditional society without contraception, where breast-feeding lasts for two years and postpartum amenorrhea, for 18 months; as a result about three pregnancies occur in seven years. In model B, with much shorter breast-feeding, and model C, with high infant mortality, the interval between pregnancies is shorter and about four pregnancies occur in seven years. Frequent abortion, whether spontaneous or induced, means as many as seven pregnancies in seven years (model D). In model E, where breast-feeding lasts 18 months and contraception begins at 6 months and lasts for 30 months, about two pregnancies would occur in seven years, with an interval of 3½ years between them. Too many pregnancies, closely spaced, can be harmful to maternal and child health.

Table 2. Levels of Contraceptive Use Needed to Prevent Increase in Total Marital Fertility Rate if Current Durations of Lactational Amenorrhea Decline to Ten, Six, or Two Months

Area, Country & WFS Survey Date	Total Marital Fertility Rate	Current Mean Length of Amenorrhea (in Months)	% Currently Using Contraception	Level of Contraceptive Use (in %) Required if Length of Amenorrhea Falls to:		
				10 Months	6 Months	2 Months
AFRICA						
Kenya 1977–78	7.7	10.7	7	10	24	38
ASIA & MIDDLE EAST						
Bangladesh 1975–76	6.4	18.5	9	32	43	54
Indonesia 1976	5.3	15.7	34	47	56	65
Jordan 1976	8.9	7.9	24	—	30	43
Pakistan 1975	6.9	13.3	6	17	30	43
Sri Lanka 1975	5.2	14.0	35	44	54	63
LATIN AMERICA						
Colombia 1976	5.3	7.2	37	—	41	52
Costa Rica 1976	4.0	5.3	59	—	—	66
Panama 1976	4.8	6.6	46	—	48	58
Peru 1977–78	6.5	9.4	29	—	39	51

Source: adapted from Lesthaeghe et al. (341)

Using World Fertility Survey data, Ron Lesthaeghe and colleagues have estimated the increase in contraceptive use that would be needed in various countries to keep fertility from rising if the length of lactational amenorrhea fell to 10, 6, or 2 months (see Table 2). The researchers conclude that in Indonesia and Sri Lanka increases in contraceptive use are likely at least to keep pace with declines in breast-feeding. In Pakistan, Bangladesh, and Kenya, however, "a real contraceptive revolution would be needed" to prevent increases in fertility in the face of declining breast-feeding (341). Estimates such as these are based on models and require many assumptions. Therefore the results are not exact, but rather give a rough idea of the increase in contraceptive use that would be needed to prevent fertility from increasing if the hypothesized declines in breast-feeding were to take place without any other significant changes.

SUCKLING, NUTRITION, AND FECUNDITY

How does the duration of breast-feeding influence the duration of infecundity? An answer to this question requires an understanding of the physiology of lactation (see box, p. J-543). The hormone prolactin, secreted as a result of an infant's suckling, stimulates the production of breast-milk and also is associated with the inhibition of ovulation (375, 542, 543, 549). A woman's levels of prolactin are highest and the duration of amenorrhea and anovulation is longest when the infant suckles frequently day and night. As suckling frequency decreases, prolactin levels fall, and ovulation resumes.

Only a few studies have tried to examine directly the link between suckling frequency and duration of infecundity. They have found that anovulation is longer with more extensive suckling (315, 376). One study found that the interval between suckling episodes influenced when ovulation resumed, but the average length of each episode and the total time that the infant suckled did not (315). In another study, however, total suckling time, as well as number of suckling episodes, were related to the length of anovulation (376). Animal studies also have shown that the anovulatory period lasts longer with stronger and more frequent suckling (294, 500, 501).

Indirect evidence for the importance of suckling comes from several observations. At the same time postpartum, women who are fully breast-feeding are less likely to be menstruating than women partially breast-feeding. In turn, partially breast-feeding women are less likely to be menstruating than women who are not breast-feeding at all (94, 115, 118, 241, 304, 370, 376, 422). Presumably these differences occur because infants suckle less when receiving food other than breast milk. Similarly, as noted, ovulation, as ascertained in a Chilean study by physiological signs such as basal body temperature and the appearance of vaginal cells, occurred first in women who were not breast-feeding at all, then in women who were partially breast-feeding, and last in women who were fully breast-feeding (433, 434). In addition, in many of the rural and poor populations of developing countries where postpartum amenorrhea lasts longest (51), most infants suckle frequently—as often as 12 to 14 times per day (605). Differences in suckling patterns probably account for some of the variations in return of menses shown in Figures 4, 5, and 6.

While intensive suckling seems to extend postpartum infecundity, it apparently does not do so indefinitely. Even among women who are fully breast-feeding, so that suckling provides their infants' only access to food, fecundity returns gradually with time. In Malaysian and Guatemalan surveys, about 20 percent of fully breast-feeding women were menstruating by 6 months postpartum; about 30 percent were menstruating by 12 months (71). Thus, although full breast-feeding clearly delays the return of fecundity for some time in many women, it is not a guarantee against pregnancy for all.

Several explanations of how nipple stimulation leads to infecundity have been proposed. At the high levels found during lactation, prolactin may act directly on the hypothalamus to prevent the surge of luteinizing hormone (LH), which stimulates ovulation (39, 237), or to change the pulse-like pattern of LH release. Or prolactin may inhibit LH and other sex hormones indirectly, through the activity of dopamine (568). Alternatively, prolactin may act on the ovary, making it unresponsive to LH and other sex hormones (373). This has been demonstrated in vitro but not confirmed. Another possibility is that nipple stimulation, as well as acting through prolactin, prevents ovulation in some way that does not involve prolactin. In a recent study, changes in hormone levels indicating return of fecundity occurred more slowly in monkeys who suckled their infants than in those who did not, even though prolactin production was experimentally suppressed in all the mothers (496).

Substantial evidence links prolactin levels with the extent of suckling. Prolactin levels are highest in fully breast-feeding women and lowest in women who are not breast-feeding (81, 125, 127, 193, 376, 547). They are higher in women whose infants suckle frequently day and night than in women whose infants suckle less often (125, 127, 376). They are higher in fully than in partially breast-feeding women (193, 376, 547). During each suckling episode prolactin levels rise above basal levels. These rises are most marked in the first several months after delivery (124, 548). Over the course of breast-feeding, a gradual decline is seen in both the basal level of prolactin and the rise in response to suckling (122, 125, 127, 133, 193, 238, 376, 544, 546). Presumably this is because infants suckle less as they grow older and begin to receive other food. Nonetheless, milk production can continue when prolactin levels are only slightly above those in nonlactating women (122).

Prolactin levels also are linked to the return of fecundity. Levels are higher for amenorrheic breast-feeding women than for breast-feeding women whose menses have resumed (121, 123, 124, 126, 127, 133, 193, 459). Also, prolactin levels are lower in breast-feeding women with ovulatory first menstrual cycles than in women with anovulatory first cycles (663). This does not necessarily mean, however, that high prolactin levels cause infecundity.

How are suckling, supplementary foods, hormonal levels, and the duration of infecundity all related? Preliminary results from a study in Scotland showed that, as supplementary foods for the infant were introduced, the duration and frequency of suckling declined. Prolactin levels declined along with the decrease in suckling, but more gradually, and ovarian activity resumed gradually. This same pattern occurred whether supplementation started as early as 3 weeks or as late as 24 weeks. None of the 27 breast-feeding women ovulated before supplementation began (376, 648). In this study breast-feeding durations were short. It is not yet known whether the introduction of supplementary foods would always lead to less suckling and thus to resumption of ovulation in other populations with different patterns of breast-feeding and supplementation. Other studies are now underway, examining in detail suckling patterns, infant food supplementation, and hormone levels, to learn more about both the behavioral and the physiological factors that reduce fecundity during breast-feeding and determine when fecundity returns (75, 185, 260).

Maternal Nutrition and Amenorrhea

A further and important question concerns maternal nutrition. To what extent, if any, does chronic malnutrition lengthen the period of amenorrhea and infecundity in breast-feeding women? Would improved maternal nutrition shorten amenorrhea and thereby increase fertility? Although the impact of maternal food supplementation on the quantity and quality of breast milk remains a matter of dispute (see box, p. J-528), the bulk of evidence indicates that maternal nutrition does not play a major role in determining the length of postpartum amenorrhea.

The hypothesis that nutrition might influence postpartum infecundity was first proposed on the basis of indirect evidence:

- Cross-cultural comparisons showing that postpartum amenorrhea lasts longer in areas where women are generally poorly nourished than where they are well nourished (159).
- Historical and clinical observations showing that improved nutritional status lowers the age at menarche

THE PHYSIOLOGY OF LACTATION

Breast-feeding depends on four physiological processes, each of which is controlled by a different system of interacting hormones:

- development of milk-producing tissues in the breast,
- initiation of milk production (lactogenesis) after delivery,
- maintenance of milk production (galactopoiesis),
- milk ejection (the "let down," or "draught" reflex) (330, 541, 549, 569).

A mother's ability to secrete milk depends on adequate proliferation of glandular tissue and ducts during pregnancy. This proliferation is stimulated by increases in estrogen, progesterone, and lactogen. Estrogen and progesterone are secreted mainly by the placenta, and lactogen, entirely so. The pituitary hormone prolactin, which activates mammary cells to produce milk after childbirth, is prevented from acting during pregnancy by the high levels of estrogen and progesterone (274, 330, 569).

Following delivery of the placenta, estrogen and progesterone levels decline rapidly, permitting prolactin levels to rise (274, 330, 569). Within 24 to 48 hours, lactation begins. For the first few days, the breast secretes colostrum, a high-protein substance containing many different antibodies. Milk production generally begins by about the second to fifth day, and mature milk is secreted after about two weeks (274, 330, 549, 569). Thereafter, continued milk production depends primarily on suckling (375, 546).

Prolactin and Oxytocin

Although the hormonal factors in milk production are only partially understood, prolactin is known to be of primary importance. The action of prolactin in milk production appears to be controlled by the presence or absence of a hypothalamic "prolactin inhibiting factor" (PIF). The infant, by suckling, causes the release of prolactin because stimulation of the nerves joining the hypothalamus and breast limits PIF secretion (274, 330, 541, 549, 569).

Milk ejection results from another hormone—oxytocin—released by the pituitary in response to suckling. Oxytocin, which also causes uterine contractions for several days after delivery, causes cells surrounding the alveoli, where the milk has collected, to contract, forcing milk into ducts and sinuses under the areola. The "let down" occurs when contracting cells and muscles within the breast force out milk that has already been secreted. A nursing mother experiences "let down" as a physical sensation in her breast within about 30 seconds to a minute after the infant starts to suckle. Contrary to popular opinion, therefore, "let down" is not caused by negative pressure created by the infant's suckling nor by rapidly increasing milk secretion, but by a neurogenic reflex which stimulates oxytocin release (274, 330, 569).

(158, 159, 162) and that starvation leads to amenorrhea (162, 522).

To conclude from these observations, however, that differences in maternal nutrition explain differences in the length of postpartum amenorrhea is not warranted (54). Other differences between cultures—particularly differences in breast-feeding patterns—can account for differences in length of amenorrhea. The Hutterites of North America are sometimes cited as an example of a well-nourished, noncontracepting population whose infants are breast-fed but where postpartum amenorrhea is brief (507). The reason for this short period of amenorrhea may not be nutritional, however, but rather infrequent suckling and early infant food supplementation (252). By contrast, a study of presumably well-nourished US women who breast-fed at frequent intervals found that postpartum amenorrhea lasted more than 12 months (304). Similarly, links between nutritional status and age at menarche or between starvation and amenorrhea cannot necessarily be extrapolated to postpartum women because different physiological processes are involved (86, 161, 522).

The best direct evidence for a strong effect of maternal nutrition on the length of amenorrhea comes from a study in the Gambia. In this study changes in both prolactin levels and length of postpartum amenorrhea were linked with changes in nutrition. Prolactin levels in breast-feeding women were higher during the rainy season, when their caloric intake is particularly low. Also, substantial supplementation of mothers' diets lowered prolactin levels (347). Lactational amenorrhea, as evidenced by estrogen levels, lasted about 10 months in the women who received food supplements compared with about 16 months in women, studied earlier, who received no supplements. As a result, average birth intervals were shorter for the women receiving supplements (348). The researchers speculate that prolactin increases in response to poor nutrition in order to maintain milk production, even if at the expense of maternal nutritional status (347). Alternatively, limited milk production in the poorly nourished women (583) might lead to more intense suckling by the infant and therefore higher prolactin levels and longer amenorrhea (641). The number of suckling episodes, already at 10 to 16 a day, did not change with supplementation (347), but detailed analysis of suckling patterns has not been reported. Another possibility is that prolactin levels rose due to stress caused by malnutrition (545) or by particularly hard work during the rainy season.

By contrast, a number of other studies have found that diet or nutritional status made little difference to the length of postpartum amenorrhea. Bangladeshi studies by Sandra Huffman and others found no relationship between maternal nutritional status and amenorrhea (100, 241, 244, 245). In a Guatemalan study, better maternal nutritional status during lactation (assessed by weight and other body measurements) and better diet (assessed by caloric intake during pregnancy and lactation) had a small, sometimes statistically significant effect in reducing the length of amenorrhea. Duration of breast-feeding, however, was a far more important factor (115–118). The infants' caloric intake in supplementary foods also had more effect on amenorrhea duration than did maternal nutrition, perhaps because of decreased suckling with increased supplementation (118). A Mexican study reached similar conclusions. Amenorrhea was shorter among mothers receiving food supplements (92), but the infants suckled less, in part because they were given supplements as soon as their growth rates or their mothers' milk production faltered (91, 93). In general, it is now thought that postpartum amenorrhea (and infecundity) may last only a few months longer in women of the poorest nutritional status than in women with the best nutritional status within a community (54, 641).

Likewise, studies have not found that a woman must be at a minimum weight or a minimum weight-for-height before her menses resume postpartum (87, 118, 241, 244, 509), as may be necessary for menarche (158, 159, 162). In fact, a Guatemalan study found that women lost weight during lactation and were losing weight even as menses resumed (118).

HORMONAL CONTRACEPTION WHILE BREAST-FEEDING

In assessing the impact of contraception on breast-feeding, research has focused primarily on hormonal contraception. Basic concerns are: do estrogens and/or progestins have any effect on the quantity or content of breast milk, and, if so, how much? Will the infant be affected? Despite more than 50 studies, the available evidence is inconclusive. The following observations can be made:

- The difficulties of measuring lactation and identifying effects of hormones make all conclusions tentative, as a number of review articles have pointed out (66, 99, 248, 326, 428, 441, 535).
- Combined estrogen-progestin oral contraceptives decrease milk volume in some cases, but pills with 0.05 mg or less of estrogen do not appear to affect infant growth.
- Progestin-only contraceptives, whether pills or injectables, either have no measurable effect on milk volume or may increase it.
- The small doses of hormones used for contraception do not appear to prevent initiation of lactation. Limited research suggests but does not prove that, when hormonal contraceptives—combined or progestin-only—are started early, milk production may not be as great as when they are started later.
- Minute amounts of hormones are transmitted to the infant in breast milk. No serious immediate effects have been observed, but long-term effects are unknown.

Research Problems

There are at least three major problems in assessing the impact of hormonal contraceptives on breast-feeding (248):

1. What aspects of breast-feeding should be measured—duration of lactation, perceived need for supplementary feeding, amount of milk obtained by breast pump, immediate or long-term infant weight gain, or composition of milk, including nutrients and hormones?
2. What standard of comparison or control group should be used?
3. To what extent do the different hormones used in various formulations have different effects?

An optimal measurement of breast-feeding and the content of breast milk would involve weighing and analyzing the composition of the milk that an infant consumes. Of course this cannot be done directly; instead, indirect measurements must be used. As a result, some studies simply ask women for their impressions. Others record the proportion of women wanting to breast-feed who are able to do so, the age of the child at initial supplementation, or the duration of breast-feeding. All these indicators, however, are influenced by personal and environmental factors that can be difficult to identify. Some studies have tried to measure the quantity of milk by weighing the child before and after a feeding, but any fluid loss must

also be measured. Some researchers have looked for possible changes in the nutritional value or hormone content of breast milk, but it is not certain whether the milk samples used are representative of the milk that infants obtain (274, 521). Furthermore, the composition of an individual woman's milk fluctuates considerably (248).

Because of the wide range of values that is considered normal, a meaningful assessment requires a comparison or control group. Some studies compare the current and past experience of the same women, even though a woman's age and other circumstances change, and her memory may be inaccurate. Other studies compare users of hormonal contraceptives with women using either other methods of contraception or none. But women who choose hormonal contraceptives may differ from other women in ways that affect breast-feeding, and it is seldom possible or ethical to assign women randomly to different methods or to placebos. Finally, both women and health personnel may have expectations or attitudes that influence their assessments unless the study can be conducted on a double-blind basis (441).

A third problem is the great variety of hormonal formulations now available. There are two estrogens and at least a dozen progestins that have been used together in different combinations and amounts in combined oral contraceptives, as well as half a dozen progestins used alone. Each of these preparations should be evaluated separately because the steroids may act and interact differently.

To emphasize the best evidence available, this review (including Tables 3 through 6, pp. J-558–563) focuses on clinical studies in which control groups were used and the number of women studied was relatively large—20 or more. As a result, several often quoted studies are not included (63, 98, 290, 345, 429, 464, 472, 539, 636, 656, 682). Even when larger, controlled studies are examined, conclusions are tentative at best.

Breast Milk Quantity and Duration of Breast-Feeding

Most but not all studies of combined estrogen-progestin contraceptives report some adverse effect on breast-feeding performance (see Tables 3 and 4, pp. J-558–560). By contrast, nearly all studies of progestin-only contraceptives have found either a beneficial effect or no effect (see Tables 5 and 6, pp. J-560–563).

Number of Groups of Breast-Feeding Women Using Different Hormonal Contraceptives, by Result

	Some Adverse Effect	Positive or No Effect
Combined OCs	21	7
Progestin-only	1	34

(Studies are summarized in Tables 3–6, pp. J-558–563. Studies with fewer than 20 women in a group or with no comparison group or no formulation specified are omitted. Each study report may include several groups using different formulations or starting the same formulation at different times.)

Six studies have directly compared combined orals and progestin-only contraceptives. Four found a reduced volume of breast milk, more infant supplementation, or a shorter duration of breast-feeding with combined estrogen-progestin pills and a neutral or positive effect with progestin-only formulations (174, 198, 240, 291). A fifth found shorter breast-feeding with three of four combined orals and longer breast-feeding with all three progestin-only formulations studied (195). The remaining study found no adverse effects for either type (454).

To minimize the impact of the many factors other than hormonal contraception that may influence breast-feeding, some studies have assigned contraceptives to women randomly on a double-blind basis, giving placebos to control groups (288, 291, 381, 502, 538). Among these studies, three of the four involving combined oral contraceptives found some adverse impact, including need for more infant supplementation (288, 291, 381); a fourth found no reduced milk yield (502). One involving estrogen alone found no impact on the initiation of lactation (538). Both of the double-blind studies on progestin-only contraceptives found a neutral or positive effect (291, 538).

The magnitude of the effects of hormonal contraceptives is uncertain. These studies report average results, and many women were not affected at all. Furthermore, studies which looked at more than one measure of breast-feeding performance sometimes found conflicting results (79, 240, 288, 291, 504).

Because the ultimate question is whether the infant is receiving enough breast milk, the most important measure may be infant weight gain (248, 291, 391). When considering weight gain, however, supplementary feeding must be taken into account (see box, p. J-530). Only two studies report the weight gain of infants receiving only breast milk. One found that a combined oral contraceptive made no difference to weight gain (79). The other found a beneficial effect with two progestin-only injectables—depot medroxyprogesterone acetate (DMPA) and norethisterone enanthate (NET EN) (298). Of the seven studies with combined orals that evaluated infant weight, the three that found significantly less weight gain used compounds with estrogen levels above 0.05 mg (ME 0.08–0.10) (313, 316, 381). The four that found no significant difference in weight gain (79, 288, 291) or caloric content of milk (240) involved lower estrogen doses. Two of these four used Norinyl 1 + 50 (with ME 0.05 mg), which is widely distributed by the US Agency for International Development (240, 281). Even when differences are seen, they may lack importance if weight gain remains in the normal range.

To some extent, differences in impact may depend on when contraception begins. Very little research has addressed this issue, however. Of three reports on women taking combined orals or estrogens alone (288, 502, 538), all but one short study (288) indicated no adverse effect on the initiation of lactation. With progestins, when users were compared with controls, none of nine major studies found any adverse effects on initiation of lactation or on early milk production when the progestins were started in the first week postpartum (17, 88, 195, 298, 313, 487, 504, 538, 631).

Studies that started the same hormonal contraceptive at various times reach a somewhat different conclusion. They have found that milk production or breast-feeding duration was generally less in the women who began use earlier. This pattern was seen in all three such studies of combined oral contraceptives (254, 381, 502) (see Tables 3 and 4, pp. J-558–560). Similarly, in two studies the beneficial effect of progestin-only contraceptives was less marked with earlier administration (195, 622), but in two it was not less (298, 504) (see Table 5, pp. J-560–562).

Another consideration is the doses of the estrogens and progestins and their independent and combined effects. Two studies have found less milk production at higher doses of progestins in combined pills (164, 291). In one of these studies the pills with higher progestin doses generally had higher estrogen doses, too (164). Two other studies, however—one of proges-

tins at two doses (195) and the other of estrogens at two doses (454)—found no difference between the doses in these combined OCs. No research has been reported on the relative effects of different doses of progestin-only contraceptives.

The estrogen component of combined pills has generally been blamed for adverse effects. Estrogen doses have dropped over the years, but studies of combined pills with 0.05 mg mestranol (ME) or ethinyl estradiol (EE), the most commonly used doses today, still report reduced milk yield and/or breast-feeding duration. With an even lower estrogen dose (0.03 mg EE), however, two recent studies could find no differences in infant weight gain, duration of breast-feeding, or duration of full breast-feeding in one case (79) or in duration of breast-feeding in the other (454) (see Table 3, p. J-558). Preliminary data from a WHO study of combined pills (0.03 mg EE) show 35 percent less milk volume after six weeks than in controls but no difference in infant weight gain (611).

Estrogens were assumed responsible for adverse effects of oral contraceptives on lactation because large doses of estrogens have been widely used to suppress lactation in women who did not want to breast-feed. Several studies of various estrogen doses compared with placebos, however, have shown that even at very large doses—much higher than those used for contraception—estrogens are not very effective at suppressing lactation (218, 290, 310, 574). Whether a woman wants to breast-feed and, above all, how much the infant is allowed to suckle now seem to be more important to the initiation of lactation than estrogen intake. This is illustrated by two double-blind studies comparing the same hormonal contraceptive (lynestrenol 2.5 mg + ME 0.075 mg) to a placebo. In one study the women did not breast-feed their infants, and the oral contraceptive and the placebo, administered for the purpose of suppressing lactation, did so with equal effectiveness (62). In the other study, in which the women were breast-feeding their infants and were taking the pills for contraception, lactation was not inhibited (502, 503).

The relative effects of the various progestins are even more complex (130, 142, 186, 286). Progestins of the same weight may differ in progestational potency, so that doses cannot readily be compared. Progestins also vary in their inherent estrogenic, antiestrogenic, and androgenic effects, which may influence their impact on breast-feeding. Further, when a progestin is combined with an estrogen, the effect differs from that of either compound separately. Whether the progestin is given orally, by injection, or by implant also may make a difference.

There are two main groups of synthetic progestins—those derived from 19-nortestosterone (which include norgestrel, norethindrone, norethynodrel, lynestrenol, and norethindrone enanthate) and progestins derived from 17α-hydroxyprogesterone (which include depot medroxyprogesterone acetate (DMPA), megestrol acetate, chlormadinone acetate, and quingestanol acetate). Although there are physiologic reasons that 19-nor derivatives might be more likely to inhibit lactation than 17α-hydroxy derivatives (413, 531), this does not appear in fact to be the case. Among 19 studies of progestins involving 35 groups of women, an inhibiting effect was found in only one (223). This was a study of chlormadinone acetate, no longer widely used, which in four other studies had a neutral or beneficial effect (88, 175, 195, 631) (see Tables 5 and 6, pp. J-560–563).

Progestin-only contraceptives may increase the level of prolactin, which would be expected to promote milk secretion. In one small study prolactin levels rose higher during suckling among DMPA users than among women using nonhormonal contraception (90).

Breast Milk Composition

Hormonal contraceptives have little effect on the composition of breast milk. Most of the studies on milk composition, conducted since the late 1960s mainly in Egypt, India, and Bangladesh, report no significant differences in the concentrations of protein, fat, or lactose between the breast milk of women using hormonal contraceptives and that of nonusers. With combined pills, some studies have found higher concentrations of protein or fat, while others have found lower concentrations, sometimes even with the same compound (see Table 7, p. J-563). With progestin-only contraceptives, the concentrations of protein and fat were generally either increased or unchanged (see Table 8, pp. J-564–565). The lactose concentration was not affected by either type of hormonal contraceptive. In Bangladesh, with combined pills, Douglas Huber and colleagues found that higher fat content compensated in caloric value for a lower volume of milk. Thus the total caloric content of 24-hour milk samples was not significantly different for combined pills, a progestin-only injectable (DMPA), and controls (240). By contrast, with two progestin-only injectables (including DMPA), several researchers working in Egypt found that fat content was lower and milk production was increased, but not enough to make up the deficit (223, 631).

In the only report on the impact of hormonal contraceptives on the immunologic protection conferred by breast milk, there were no significant differences in immunoglobulin concentration between breast milk of women using DMPA or NET EN and those who were not (145).

Hormones in Breast Milk

Small amounts of steroids from hormonal contraceptives appear in breast milk, are consumed by the infant, and can be detected in the infant's blood plasma. Reported short-term effects appear to be rare and minor. The chances of any long-term effects have not been studied, but the adverse effects on the fetus of hormones administered in early pregnancy have raised concerns about steroid transmission in breast milk.

The most comprehensive investigation of hormones in breast milk has been conducted by Staffan Nilsson and colleagues in Uppsala, Sweden (411, 412, 413, 414) (see Table 9, p. J-565). They measured the levels of progestin and estrogen compounds in both maternal blood plasma and breast milk. For all hormones measured, the dose received by the infant was far less than one percent of the maternal dose, a finding similar to those of other studies—both early studies of radioactively labeled steroids (328, 329, 398, 438, 560, 592) and other, more recent studies using radioimmunoassays (311, 494, 533). The progestins differ in how much of the maternal dose appears in the breast milk, however. With megestrol acetate, a 17α-hydroxy derivative, the ratio of steroid concentration in maternal plasma compared with the concentration in milk was 100:80 (413). With norgestrel, a 19-nor derivative, the ratio was much lower—100:15. Nilsson and colleagues studied various doses of norgestrel. At the dose used in progestin-only contraceptives, the concentration of the hormone in milk was too low to be detected. At higher doses, such as those used in combined OCs, the hormone could be found in breast milk and in the infants' blood plasma. The concentration in the infants' blood was similar to what would be seen in women who had taken an equivalent oral dose of norgestrel; this indicates that the infant metabolizes and excretes the hormone at about the same rate as the mother (411).

Other studies also have found that the proportion of the progestin appearing in breast milk is greater for 17α-hydroxy derivatives than for 19-nor derivatives, whether given as pills, implants, or injections (311, 494, 533, 540). With contraceptives taken orally each day, the quantity of steroids received by the infant remains the same from day to day. Because an injection at first produces relatively high serum concentrations of contraceptive hormone, the daily dose to the infant is also relatively high at first and then declines. This high initial dose might be of particular concern if an injection were administered immediately postpartum, when the infant's ability to metabolize and excrete the drug is most immature (216, 465). With one of the new implants, which gradually release a controlled dose, norgestrel was not detectable in milk after the first day and norethindrone, not after the first week (540).

Estrogens appear to be transferred to the infant less than the 17α-hydroxy progestins but more than the 19-nor progestins. EE, for example, has a moderately low plasma-to-milk concentration ratio—100:25. Very low absolute amounts appear in breast milk, and the infant receives a very small proportion of the daily maternal dose (412) (see Table 9, pp. J-565–566). At the doses used for contraception, Nilsson and colleagues could not detect EE in milk (412). The endogenous estrogen estradiol also has been evaluated, both because it is naturally present in the blood plasma of adult women and because it is a potential contraceptive (26, 414, 609). Its plasma-to-milk concentration ratio is less than 100:10, and the absolute amount passed into the milk is extremely small (414).

In studies of hormone levels at specified intervals after administration of combined or progestin-only pills, levels in both plasma and milk were highest at 2 or 3 hours and dropped thereafter (408, 411–413, 494, 540). Thus women taking orals could minimize hormone reaching the infant by taking pills either just before or after a feeding and when the time to the next feeding would be longest—perhaps the last evening feeding or, if a mother leaves her infant to go to work all day, the morning feeding (48).

The difference between progestins in the proportion of the maternal dose transferred to breast milk may be at least partially due to the differing capacities of progestins to bind with serum hormone binding globulin (SHBG) in the mother's blood. Only the portion that is not bound to SHBG can pass into the milk (411–415, 565, 566). High SHBG levels in the immediate postpartum period may mean that more of the hormone will be bound and less passed into the milk during this period (415, 484). The lower fat content of colostrum compared with mature milk (330, 630) also suggests that steroid transfer may be relatively low during the first few days after delivery. Contraceptive steroids are fat-soluble and thus are found in higher concentrations in the high-fat milk obtained at the end of a feeding than in the low-fat milk obtained at the beginning of a feeding (411, 413).

The critical question, which remains unanswered, is what effect these small amounts of hormones may have on the infant. No link between hormones consumed by breast-fed infants and subsequent diseases or developmental disorders has been established, but potential long-term effects have not been thoroughly studied. As for short-term effects, there have been case reports of transient breast enlargement among infant sons of women taking combined oral contraceptives (110, 356, 412). This may be due to the estrogen component of the pills. Neonatal breast enlargement attributable to natural maternal estrogens occurs commonly and subsides spontaneously, however (42, 110). Several studies that have looked for possible effects on infants have not found any (98, 298, 299, 381, 506).

The reason for concern about infants receiving hormones is that naturally produced hormones are known to influence normal physical development at various points. Furthermore, early in pregnancy, fetal exposure to administered hormones or abnormally produced natural hormones (such as those produced by a tumor) can lead to birth defects (594) or, in the well-known instance of the estrogen diethyl stilbestrol (DES), vaginal cancer when a daughter exposed in utero reaches adolescence (228). In late pregnancy, however, levels of natural estrogens and progesterone are high, without adverse effect on the fetus or on subsequent development. Male infants may be especially susceptible from one to three months when testosterone levels rise and then fall (154). Thus the time of administration may be crucial, but more study is needed.

Animal studies, although not necessarily applicable to humans, are useful for studying long-term effects because animals have shorter life spans. Three studies have found adverse effects on the rate of sexual maturation or on subsequent fertility in rats whose mothers received certain progestins during lactation, generally at doses higher than those used by women for contraception (10, 179, 493). A fourth study found no effect in rats at five times the equivalent human dose (570).

Several other issues have been raised about the use of hormonal contraceptives during breast-feeding, but little clear evidence is available to resolve them:

- In the immediate postpartum period women are at higher than usual risk of thromboembolic disease (310, 570). Since, to varying degrees, oral contraceptives increase the risk of thromboembolic disease (474), women who use them in the immediate postpartum period might be at particularly high risk.
- One study found that nursing infants of OC users had higher rates of neonatal jaundice than other infants (602), but other studies found no such association (40, 180, 368).
- Several reports suggest that amenorrheic breast-feeding women who take the pill resume menstruating sooner (394, 454) and, if they stop the pill, become pregnant sooner (50) than women who have taken no pills. Other studies and comments raise some doubts, however (239, 436). Menses-like withdrawal bleeding after a cycle of pills does not indicate ovulation, return of which depends primarily on suckling patterns.

In summary, research to date suggests that combined orals at certain doses reduce the volume of breast milk in some women, while progestin-only contraceptives—whether oral, implant, or injectable—may have no effect or may increase milk volume. In any case, the effects of hormones used in low doses on milk quantity and composition do not appear to be great, although the possibility of long-term effects on infants from transmitted steroids has been neither confirmed nor dismissed. Overall, observed effects of combined orals do not seem to be large enough to rule out these contraceptives for breast-feeding women who want to use them (see p. J-554).

ENCOURAGING BREAST-FEEDING

The challenge for family planning programs, either as separate programs or as part of integrated primary health care, is

- to preserve breast-feeding where it is now common and to encourage and facilitate breast-feeding where the practice is declining, as well as
- to provide safe and effective means of contraception to breast-feeding women at the appropriate time to prevent unwanted pregnancies.

Breast-feeding should be promoted for reasons related directly to infant nutrition and health, not primarily for contraception. The contraceptive protection provided by breast-feeding is too uncertain for individual women when modern family planning methods are available as an alternative. Thus two strategies are necessary. Where prolonged breast-feeding is common, women should be encouraged to continue breast-feeding and to use contraception to prevent another pregnancy that would interrupt breast-feeding. Where breast-feeding is now declining, women should be encouraged for the health of the infant to breast-feed as long as feasible and to start effective contraception before lactational infecundity ends.

National Programs to Encourage Breast-Feeding

In the past decade over 15 countries have adopted policies or programs to encourage breast-feeding, for both health and economic reasons (35, 274). The policies have been of two types: (1) demand policies, which attempt to increase women's motivation to breast-feed by educating women and health professionals and by changing hospital and employment practices to facilitate breast-feeding; demand policies also would deter bottle-feeding by limiting advertising of infant formula; and (2) supply policies, which make bottle-feeding more difficult by restricting the availability and supply of infant formula, bottles, and nipples (35). Most of the national progams are in the early stages of development, and their effectiveness cannot be fully gauged.

Many developing countries have instituted educational, or demand-oriented programs. They include Brazil, Colombia, Indonesia, Jamaica, Malaysia, Mexico, Thailand, and Trinidad and Tobago (1, 14, 35, 492, 525, 629, 644, 676). Some have placed limits on the advertising practices of companies that market infant formula. In at least four countries—Argentina, Malaysia, Singapore, and Papua New Guinea—women's groups provide support and encouragement for breast-feeding by visiting new mothers in hospital wards and at home (274, 319, 532). Another way to encourage breast-feeding is to make it easier for working women. Many nations encourage nursing breaks, permit shorter working hours, call for creches (nurseries) in places of employment, and in other ways attempt to facilitate nursing (279, 473, 605). In Nicaragua a broad effort to promote breast-feeding has been proposed, including

- prenatal education,
- supplementary food programs for lactating women,
- mass-media advertising,
- breast-feeding education in schools and universities,
- mandatory maternity leave before and after childbirth,
- creches at work places, with lactating women granted a free hour daily to breast-feed, and
- legislation to control marketing and promotion of breast milk substitutes (35).

A small number of countries have instituted supply-type policies. Ghana and Jamaica have restricted the import of infant formula, and in Guinea-Bisseau and Papua New Guinea formula, bottles, and nipples can be sold only in pharmacies on a doctor's prescription. Algeria has nationalized the import of all infant formula, thus eliminating advertising and promotional efforts of infant formula manufacturers (35).

The frequently cited program of Papua New Guinea, which operates mainly in the capital city of Port Moresby, combines demand and supply policies. Demand policies were started in 1975. Health workers began to promote breast-feeding. Hospital staffs and local women's groups taught women breast-feeding techniques. Manufacturers were forbidden to distribute formulas in hospitals, and all advertising of formula on the radio was banned. By 1977 it was clear that these measures were not increasing the rate of breast-feeding, and legislation was passed making bottles, nipples, and formula available by prescription only. Before issuing a prescription, a health worker is required to instruct the woman in the proper preparation and storage of formula (18, 319). The program has not been fully evaluated. Small surveys suggest an increase in breast-feeding in Port Moresby, from 65 percent to 88 percent of children under 2 years old at the time of survey (18, 319).

In May 1981 the World Health Assembly approved an International Code of Marketing encouraging countries to restrict advertising, distribution of free samples, and other promotion of infant formula and to ensure proper labeling (608). The US government, although it provides support for a number of breast-feeding programs (263, 264, 555), opposed the code on the grounds that it recommended a complete ban on advertising infant formula to the general public, which runs counter to US constitutional guarantees of free speech (556).

Many observers believe that easy access to breast milk substitutes and exposure to misleading advertisements by in-

Breast-feeding is declining in urban areas of many developing countries. How much effect do urbanization, jobs outside the home, and other modern influences have? Or does the promotion of infant formula, prominently displayed here by a shopkeeper in the Yemen Arab Republic, discourage breast-feeding? (Stina Almroth)

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fant formula manufacturers encourage the use of formula by families who do not recognize the full implications of stopping breast-feeding (32, 151, 189, 274, 447). On the other hand, programs restricting the availability of infant formula are controversial because they limit individual choice (6, 437). Edward Baer, Associate Director of the Infant Formula Program of the Interfaith Center on Corporate Responsibility, notes that:

> The task facing national governments . . . is to find ways to make breast milk substitutes available to those who really need them, without implicitly or explicitly promoting their use for the whole population. (35)

Role of Health and Family Planning Personnel

While governments may consider a wide range of policies to promote breast-feeding or to discourage bottle-feeding, family planning and maternal and child health programs can play a very practical and positive role in encouraging breast-feeding by

- providing information and support for breast-feeding to women and their families from the beginning of pregnancy,
- helping to solve breast-feeding problems,
- changing hospital and clinic routines to help establish lactation and to eliminate artificial feeding from maternity wards, except when indicated for strictly medical reasons.

These measures can increase both a woman's motivation to breast-feed and her ability to do so successfully.

Family planning and other health workers should know about breast-feeding techniques so that they can teach the "art of breast-feeding" to women. Several surveys have shown, however, that health professionals are often misinformed about breast-feeding (68, 211, 342). All health workers should be taught that frequent suckling—the pattern of breast-feeding in many traditional societies—is necessary to maintain a high level of milk production. Frequent suckling is especially critical in the first weeks after childbirth, when lactation is being established. If there are long intervals between feedings or rigid schedules, the reduced suckling causes shortages of milk. A woman may then have to supplement breast-feeding or turn entirely to bottle-feeding. Early supplementation with cow's milk or other foods further limits the production of breast milk since an infant who is not hungry may be less inclined to suckle. Traditional practices such as delaying breast-feeding for two to four days after birth or nursing with only one breast may also reduce the milk supply (5).

Frequent feeding also may alleviate some of the common problems of breast-feeding—sore and cracked nipples, breast engorgement, and breast infections—which sometimes unnecessarily curtail breast-feeding (604). In an early study of over 100 women, those feeding on a rigid 4-hour schedule had more nipple soreness and breast engorgement than women feeding their infants "on demand" (255). Also, infrequent feedings can cause milk to pool in the breast and lead to inflammatory mastitis (270).

Family planning workers can assure women that nipple soreness usually stops within several weeks after delivery. Exposing the breasts to the air or to dry heat helps dry and toughen nipples. If only one nipple is affected, women should breast-feed the baby on the opposite breast first in order to permit the milk to let down, thus reducing the suckling pressure on the sore nipple (330, 604). Continued breast-feeding is also recommended if a woman develops mastitis. Breast-feeding women should be alert to the symptoms of mastitis—redness and pain in one or both breasts—and should be advised to obtain medical treatment as soon as possible (330).

In addition to information about breast-feeding techniques, women also need confidence that they can breast-feed successfully. Lack of confidence as well as stress and anxiety may interfere with the milk ejection (or "let down") reflex, which makes the milk accessible to the infant (272, 330). If the breast milk does not let down, the mother may believe her supply is inadequate and turn to bottle-feeding. In traditional societies other women—sometimes called doulas (272, 468)—provide support and encouragement to new mothers. The absence of this support in modernized societies may impair a woman's ability to breast-feed (468). In these societies support can come at least partly from health workers instead. A woman's confidence in her ability to breast-feed may also be increased if she keeps a growth chart for her child and, when the child is weighed during clinic visits, records the child's weight gain (391, 607). The growth chart also alerts health workers to child health problems (191, 391). (See photo, p. J-552.)

Information and support for breast-feeding should begin early in pregnancy. In modern medicine, care for all aspects of breast-feeding has fallen to the pediatrician (600). Yet many women choose during pregnancy which method of feeding to use (138, 285). Thus, obstetricians and midwives are often in the best position to encourage women to begin breast-feeding.

Changing Hospital and Clinic Routines

Physicians, midwives, and other health workers can actively encourage breast-feeding not only by providing information to their clients but also by altering hospital and health center policies that discourage breast-feeding. Since many women in urban areas deliver in hospitals, these policies have wide impact. Studies in Thailand and Malaysia found that women who had delivered in medical facilities were less likely to breast-feed than women who delivered at home even after taking into account the influence of socioeconomic status (73, 307). This suggests that hospitals may have discouraged breast-feeding, and could be one reason that urban women breast-feed less.

Hospitals in both developed and developing countries discourage breast-feeding by separating the mother and infant immediately after childbirth, administering lactation suppressants, offering unnecessary supplementary bottle feedings, establishing inflexible feeding schedules, and, during labor, performing episiotomies routinely, causing the mother pain which may interfere with "let down," and administering certain drugs such as barbituates, which may impair a newborn infant's ability to suckle (64, 250, 600, 605, 610). In some hospitals in Costa Rica, Guatemala, and Zaire, for example, women are separated from their infants for 12 to 24 hours or for the entire hospital stay, thus preventing early initiation of breast-feeding (365, 517, 605). A Jamaican study found that supplementary bottle-feeding in the hospital—often routinely given without medical indications—increased the likelihood of early weaning. Only 5 percent of the women whose infants were supplemented returned to full breast-feeding at home (181).

Changing these hospital policies can facilitate breast-feeding (365, 517, 600). In two of three Guatemalan hospitals the mean duration of breast-feeding was significantly greater among women who were allowed to breast-feed their infants immediately after delivery than among women who did not see their infants for 12 hours (517).

Restricting the availability and promotion of infant formula in hospitals also may encourage breast-feeding. In some countries representatives of infant formula manufacturers have visited hospitals and given free samples of formula to newly

delivered mothers (605, 664). Representatives often wore nursing uniforms (188, 189). In addition, maternal and child health centers and maternity wards have displayed posters advertising infant formula. Eliminating these practices should help avoid giving mothers the impression that health workers favor bottle-feedings.

Family planning clinics and staff also may play a role in encouraging breast-feeding. In Malaysia women who lived nearest to (and presumably attended) integrated maternal and child health care clinics were significantly more likely to start breast-feeding and to breast-feed longer than women who lived near family planning clinics on tea plantations. While other factors may be responsible, it is possible that the staffs of the tea plantation clinics discouraged breast-feeding or simply failed to discuss it at all (73).

Women who have to combine breast-feeding with jobs or other activities outside the home should be encouraged to try mixed feedings, either using prepared formula or expressing milk from the breasts by hand or with a manual pump, instead of giving up breast-feeding altogether. Women who are definitely planning not to breast-feed should be given full and careful instructions on how to prepare, store, and administer other food safely.

Overall, since women are moving into urban areas, taking paying jobs, and discovering alternatives which they may prefer to traditional ways, breast-feeding is unlikely ever to be as universal and prolonged as in the past (452). Yet the experience of developed countries suggests that trends in breast-feeding have been strongly influenced by changing biomedical knowledge. During the 1940s, 50s, and 60s, while breast-feeding was declining, medical textbooks and scientific literature offered little justification for preferring breast to bottle (70). As William Butz notes, "The scientific evidence that breast-feeding provides a superior infant food and a natural contraceptive was only established in the late 1960s" (70). As that evidence has been disseminated among both health personnel and the general public, the percentage of women breast-feeding has increased, beginning with the most educated groups. In developing countries today, however, perhaps because of a lag in dissemination of this knowledge, breast-feeding is practiced least by educated urban women. It is possible that in developing countries also, as health professionals and individual women become better informed about the proven health benefits of breast-feeding, more of them will encourage and support this traditional practice, but for well-established scientific reasons.

In some hospitals newborn infants are separated from their mothers and given water and other fluids by bottle—which may make breast-feeding more difficult when the mother and child return home.

CONTRACEPTION DURING BREAST-FEEDING

Providing safe and effective methods of family planning for breast-feeding women is an important concern for family planning programs. Breast-feeding women constitute a substantial percentage of ever-married women of reproductive age in many developing countries (see Figure 8). After the first few months of breast-feeding, these women run an increasing risk of becoming pregnant, and they have a particularly strong reason to avoid immediate pregnancy.

In determining which contraceptive methods should be provided to breast-feeding women and when, family planning workers need to consider at least four different factors. These are:

1. the personal preference of the woman,
2. the availability and convenience of different methods or procedures at different times, which often has a great impact on choice of contraceptive,
3. the impact on fertility of starting different methods at different times after delivery, which, like other considerations, varies greatly depending on personal and community circumstances, and
4. the possible effects on lactation, which so far have been studied mainly with respect to hormonal contraceptives.

Theoretically, each of these four factors—personal preference, availability, fertility impact, and effects on lactation—should be taken into account in choosing a family planning method and deciding when to start it. There are eight major family planning methods—combined oral contraceptives, progestin-only contraceptives, IUDs, male or female sterilization, barrier methods, coitus interruptus, and periodic abstinence—and there are at least five different times when a method can be started—immediately postpartum, after a postpartum check-up, when food supplementation starts, when menses resume, or at some specific date, such as 6, 12, or 18 months postpartum.

In practice, these many possibilities tend to be reduced to three questions:

- What methods can be initiated immediately postpartum or at an early postpartum check-up?
- How long can a breast-feeding woman delay the use of contraception and still be reasonably sure of avoiding another pregnancy?
- When can hormonal contraceptives of various types be introduced without the risk of seriously affecting lactation?

Postpartum Services

Programmatic availability and personal convenience will always be important factors in the choice and use of contraceptives, especially when evidence of adverse effects is inconclusive. Thus a great deal of attention has focused on the provision of family planning services immediately after deliv-

ery. This is most appropriate for women who deliver in a hospital or health center and so are in close touch with health personnel at that time. Although fully breast-feeding women are infecund for a minimum of several months after delivery, the overlap in contraceptive protection with methods started immediately postpartum should be weighed against the possibility that women may not return later for a postpartum visit or for family planning services. Furthermore, even though some women may not wish to begin contraception immediately, family planning education at the time of delivery may lead to greater acceptance of family planning services later (683).

Combined oral contraceptives are not a recommended method for use immediately after delivery. Recognizing that these contraceptives may have an adverse effect on lactation, a number of organizations, including the International Planned Parenthood Federation (IPPF) Central Medical Committee (262), the WHO Expert Committee on Maternal and Child Health (610), and the American Public Health Association (21, 22), suggest that preference be given to other methods, especially while the infant is very young. IPPF, for example, advises that "combined oral contraceptives should not be started until lactation is well-established" (262). The American Public Health Association recommends "other family planning methods, especially when human milk is the infant's only source of nutrients" (21). Furthermore, since many women discontinue orals after a few months, early use by breast-feeding women provides protection when it is least needed and may result in no protection later, when it is most needed. Oral contraceptives could, however, be provided soon after delivery with instructions to begin their use later.

Postpartum IUD Insertion

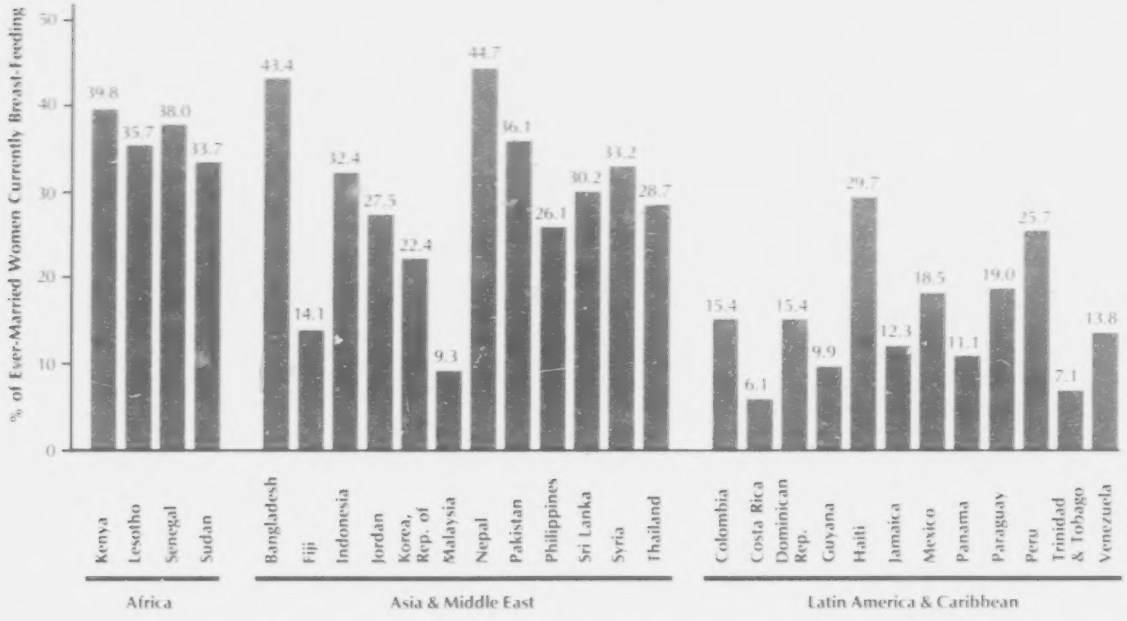
Some contraceptive methods are more appropriate for use immediately postpartum. IUDs, for example, have many advantages for women who deliver their babies in a hospital or health center and want to use a highly effective method immediately. Postpartum IUD insertion is safe and convenient (483). IUDs seem to have no effect on lactation. Comparing IUD users and women using no contraception, two studies found longer breast-feeding by users (174, 293); one, shorter (79); one, no difference (454). No differences were seen in milk quantity (222) or infant growth (79) (see Table 10, p. J-566–567). Although it has been suggested that an IUD might influence lactation by stimulating oxytocin secretion, in fact no such increase has been found (174). The most recent studies have also found no increase in prolactin levels in IUD users (33, 520, 578), although two earlier reports did (157, 658). Also, IUDs do not appear to affect milk composition (222).

One disadvantage of IUD insertion immediately postpartum is that expulsion rates are somewhat higher then (483, 537, 582). Breast-feeding, however, appears to make no difference (103). To minimize expulsions, the International Fertility Research Program has developed postpartum IUDs with biodegradable sutures tied to the upper arm of the IUD. These help to keep the device in place while the uterus resumes its normal nonpregnant size. Then the sutures gradually dissolve (532). Even if devices are expelled, however, many women return for reinsertion (140, 537, 683). Once in place, the IUD is an effective method of contraception, and an average of 70 to 80 percent remain in place for at least one year. After menses resume, however, heavy bleeding in some women with nonmedicated IUDs may contribute to anemia. (See **Population Reports**, *IUDs—Update on Safety, Effectiveness, and Research*, B-3, May 1979).

Postpartum Sterilization

Voluntary sterilization is an appropriate postpartum method of fertility control for breast-feeding women who deliver in hospitals or health centers and want permanent protection against another pregnancy. Postpartum sterilization has been practiced throughout the world for decades without reported adverse effects on breast-feeding. One study, involving 36 women, has been published specifically on the effects of voluntary sterilization on breast-feeding (137). Women who were sterilized within 24 hours after delivery produced milk in

Figure 8. Percentage of Ever-Married Women Currently Breast-Feeding in 28 Countries, World Fertility Survey Data



Note: This figure reports the percentage of ever married women breast-feeding at the time of the survey. Women were age 15–49 except in Costa Rica, Panama, and Venezuela, 20–49. Source: Ferry & Smith (150)

quantities similar to those of the unsterilized control group, but women sterilized four to six days after delivery produced less milk for as long as two weeks postpartum. This suggests that an adverse effect may occur—perhaps because of anesthesia—if sterilization takes place at the time when milk production is beginning. More studies of this possibility would be useful. If such an effect exists, it could be minimized by using regional or local anesthesia at the lowest effective level.

At a point just after delivery, when a woman is beginning breast-feeding, may be an opportune time for her husband to obtain a vasectomy (453). During the 2- to 3-month period after vasectomy that sperm remain in the male genital tract, a breast-feeding woman is likely to be infecund, and after that the couple will be protected. In areas where infant mortality is high, however, couples might choose to delay sterilization of either partner at least until the last child is safely weaned.

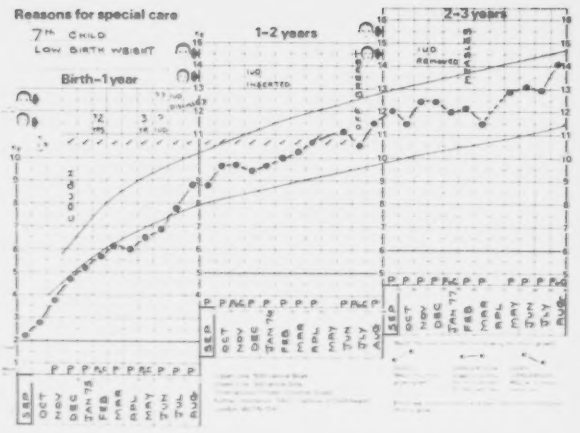
Postpartum checkups, usually recommended for about six weeks after delivery, provide a good opportunity both for contraceptive advice and for any help that may be needed with breast-feeding. In many developing countries women do not return for postpartum care, but, when they know that family planning services will be provided at that time, they are more likely to return, as the International Postpartum Family Planning Program showed (683). Still, one study has found that more than half of the women delivering in hospital who planned to return for a postpartum IUD insertion in fact did not return (140). Nevertheless, the postpartum check-up is an appropriate time for breast-feeding women to consider IUD insertion, fitting of a diaphragm, or starting use of barrier methods. Barrier methods or the practice of coitus interruptus (withdrawal) may be especially appropriate for breast-feeding women in cultures where sperm is thought to poison or contaminate breast milk (684).

Where prolonged sexual abstinence is practiced during breast-feeding, of course no methods of contraception are needed until sexual activity begins. Use of periodic abstinence (rhythm, or Natural Family Planning) is difficult for breast-feeding women (see **Population Reports,** *Periodic Abstinence: How Well Do New Approaches Work?*, I-3, September 1981). Even after menses resume, patterns of ovulation, and thus basal body temperature and cervical mucus, may be erratic, requiring extended periods of abstinence.

Throughout the postpartum period—and, in fact, even from the beginning of pregnancy—although the pregnant or breast-feeding woman has no immediate need for contraception, she is probably in closer contact with health personnel than at any other time. Therefore health personnel should make every attempt during this time both to encourage breast-feeding and to help women plan for adequate contraception later, when fertility returns.

When to Begin Contraception

Another question with important program implications is: How long after delivery can a breast-feeding woman wait to use contraception and still be reasonably sure of avoiding another pregnancy? For the individual woman, this is an extraordinarily difficult question to answer. As noted (see Impact of Breast-Feeding on Fertility, p. J-539), the overall likelihood of becoming pregnant increases with such interrelated factors as (1) the length of time after delivery; (2) diminished infant suckling, which may in turn be caused by (3) the introduction of other food for the infant; (4) the resumption of menses; and (5) the resumption of normal ovulation. Of course, a woman's



This sample growth chart shows that the infant, a seventh child, weighed less than normal at birth but after about a year reached and remained in the normal range. (Courtesy of David Morley) (391)

age and fecundity and her ability to use contraception are also important.

A mathematical evaluation of the optimal time to start contraception found substantial variation in the effect on fertility under different conditions (448, 449). If the period of postpartum infecundity is short, if a high proportion of first menstrual cycles are ovulatory, if fecundability is high, and if contraceptive continuation rates are high, then starting contraception soon after delivery is the best strategy. These conditions are most likely to apply to young urban women who tend to breast-feed for a shorter period than rural women and who are more likely to deliver in a hospital, where IUD insertion can be provided immediately or during a postpartum visit. For these women, starting contraception with an IUD no later than the first postpartum visit would be reasonable. As the duration of breast-feeding (and therefore of infecundity) increases, the effectiveness of starting contraception immediately postpartum depends largely on continuation rates.

A prospective Philippine field study of pregnancy rates after delivery illustrates these interrelationships (394, 422). Among 794 urban Philippine women, 76 percent breast-fed, and for an average of 10.3 months. Among these women, the overall pregnancy rate at one year after resumption of menses was lower for IUD users than for users of oral contraceptives primarily because IUD continuation rates were higher. This was the case even though most IUD users had the devices inserted immediately postpartum, while most users of the pill started several months *after* first menses. For the IUD users, there was about a 4-month period of unneeded protection, or overlap, before first menses, but because the continuation rate was high—79 percent at one year—the overall pregnancy rate was low. For the pill users, because continuation rates were low, the pregnancy rate was high even though on the average pill users did not start until five months postpartum.

In the rural areas of most developing countries, conditions are different. Breast-feeding is almost universal and, since most women give birth at home, postpartum sterilization or IUD insertion is not feasible. A field evaluation that included some consideration of the optimal time to start contraception was undertaken in Matlab Thana, Bangladesh (436), where virtually all women breast-feed and where the duration of postpartum amenorrhea averages about 18 months (241, 463). In one area women were advised to begin oral contraception at 6

28

months postpartum, and in another area, at 18 months or first menses, whichever came first. (Whether they followed this advice, especially with regard to starting at 6 months, is not certain.) Among women over age 30, who showed the largest decline in fertility, there was no difference in fertility rates between the two areas (436).

At First Postpartum Menses?

Ideally, contraception should begin just before ovulation resumes, but in practice it is impossible for an individual woman to predict the start of normal ovulation. For most women, the first sign of returning fertility is first menses. Thus there is much justification for recommending that contraception start at that time. Certainly, after first menses any woman who wants to avoid pregnancy should be instructed to use contraception, whether she continues breast-feeding or not.

The longer breast-feeding continues, however, the greater the likelihood that ovulation will occur before first menses. In a Chilean study, among breast-feeding women who resumed menstruating 60 days or more postpartum, ovulation preceded first menses in 72 percent (434). Thus, if a woman waits until first menses to start contraception, she runs a steadily increasing risk of becoming pregnant.

Another disadvantage of delaying contraception until first menses is that contraceptive supplies and services may not be immediately available. Unless a woman already has contraceptive supplies at hand or unless field support services bring supplies to her quickly, the start of contraception may be delayed for several months. Depending on the length of time after delivery and the amount of suckling, the risk of becoming pregnant for the breast-feeding woman just after first menses may be almost as great as for the woman who is not breast-feeding.

With Suckling and Feeding Changes?

The direction of current research suggests that the frequency and intensity of suckling influence the duration of infecundity (see pp. J-542–543). If suckling frequency is reduced from 10 feedings per day to 6, for example, or if night feeding is eliminated, this change may lead to ovulation. Thus, if a specific time can be identified when infant suckling patterns change considerably, that might be an appropriate time to start contraception.

An important influence on suckling patterns may be the introduction of supplementary food as a regular and substantial part of infant diet. Although the extent—and indeed the definition—of supplementation varies greatly in different cultures, recent evidence suggests that infant food supplementation influences infant suckling, which in turn influences prolactin levels, milk production, and eventually ovulation. As a result, food supplementation precedes ovulation more often than first menses does and therefore, as an indication for starting contraception, provides a greater margin of protection against pregnancy. Moreover, since food supplementation may imply a definite change in the behavior of the mother feeding her child, it might not be difficult, from a programmatic standpoint, to link that change with the start of contraception or with the shift from a less effective method to a more effective one. Where food supplementation is introduced at a time that can be clearly defined and is closely associated with changing patterns or schedules of infant suckling, as in Alan McNeilly and colleagues' studies in Scotland (376, 648), such a recommendation would be reasonable. Even with present limited

BREAST-FEEDING DURING PREGNANCY

If breast-feeding women become pregnant, should they continue breast-feeding? Although pregnancy is one of the major reasons for stopping breast-feeding (242, 274, 482, 605), practices vary greatly, and there has been little research on what problems may be involved in breast-feeding during pregnancy.

Some women continue breast-feeding until the third trimester of pregnancy (94, 242, 353), and a few, even after another birth, so that the older and the younger child are breast-feeding "in tandem" (330). The WHO Collaborative Study showed that in rural areas of Ethiopia, Zaire, and Guatemala, 30 to 40 percent of pregnant women were still breast-feeding, and in rural and poor urban areas in India about 70 percent of pregnant women were breast-feeding (605). Other women believe that pregnancy changes the quality of breast milk and that continued breast-feeding may be harmful to the suckling child (242, 407, 482, 567). Therefore they stop breast-feeding when a new pregnancy occurs. Still others stop nursing because they believe their supply of breast milk has diminished (242, 482). In a study in Bangladesh, for example, over half of the women who stopped breast-feeding because of "insufficient milk" were pregnant (242). An abrupt end to breast-feeding because of pregnancy may be dangerous to the infant. In a Senegal study, death rates were twice as high for infants age 12 to 17 months who were weaned because their mothers were pregnant as for all infants weaned at that age for whatever reason (85).

Are there physiological reasons for breast-feeding to diminish during pregnancy? In the later months of pregnancy a woman's milk production may decrease due to the high level of circulating estrogens and progesterone (569). In a US study of 158 women who breast-fed throughout pregnancy, 13 percent noted a sharp decrease in their milk supply and 52 percent noted a gradual decrease. Thus two-thirds of the women perceived a reduction in milk volume in the first four months of pregnancy (660). Reduction of milk yield during pregnancy has been reported in rats and cattle (541).

It is not clear whether the composition of breast milk changes when a woman becomes pregnant, but no changes that would require an end to breast-feeding have been suspected. In a study in Zaire, H. J. Vis and P. H. Hennart found that the breast milk of pregnant women was similar to colostrum in composition, with higher levels of protein and lower levels of fats and lactose than the mature milk of nonpregnant women (567).

The main problem is the nutritional status of the mother. Ideally, both pregnancy and lactation require supplementation of the mother's normal diet. With adequate maternal supplementation, breast-feeding during pregnancy does not seem to be harmful, although very little research has been undertaken on the subject. Without adequate maternal supplementation, lactating women who are also pregnant face a heightened risk of malnutrition, which may also affect both the suckling child and the new pregnancy.

knowledge, child health workers and family planning personnel can point out the possible link between infant diet and maternal fecundity and thus the increased need for contraceptive protection after food supplementation begins.

Another consideration in advice about breast-feeding and contraception is the previous experience of the individual woman. If she has breast-fed before and can identify any consistent patterns in the length of postpartum amenorrhea or in suckling behavior or food supplementation, these should be taken into account in deciding when to start contraception (317). Although each infant will be different, the mother's own lactational and fertility experience, as well as the experience of the community (391), can be a useful guide as long as other conditions have not changed. More research is needed, both on different patterns of suckling and supplementation and on hormonal changes in the mother, before more specific recommendations can be made.

Choice of Hormonal Contraceptive

For a breast-feeding woman who wants to avoid pregnancy but does not want to use nonhormonal methods or does not have easy access to them, a major concern is whether hormonal contraceptives can be used after lactation is established and, if so, which formulations are best and when use should start.

Because progestin-only contraceptives—in injectable, oral, or implant form—have not been shown to have any adverse effect on lactation and may augment milk production (see p. J-545), some experts recommend that progestins, rather than combined oral contraceptives, be used by breast-feeding women (262, 276, 481). Using progestin-only contraceptives during lactation would have the further advantage that any disruption in menstrual cycles due to the progestin might be expected and therefore less disturbing to the mother. It has also been suggested that women should start by using progestin-only compounds and then, at six months or after first menses, shift to combined pills for greater protection (481). Malcolm Potts has proposed that, to emphasize the preferability of progestins, progestin-only oral contraceptives be packaged with a picture of a breast-feeding infant, and the combined oral contraceptives, packaged with a picture of a woman and an older child (451). On the other hand, progestin-only oral contraceptives have higher failure rates and higher rates of break-through bleeding. These might not be serious problems during breast-feeding, but, after breast-feeding ends, a woman using progestin-only compounds might want to shift to a combined pill for greater effectiveness and menstrual regularity.

Because daily progestin-only pills or progestin implants may minimize and delay the transfer of any steroids to the infant, they theoretically have an advantage over injection as a means of administration. Whether or not the larger milk volume reported with DMPA, the mostly widely used injectable, means an increase in nutrients or outweighs any potential dangers of steroid transmission to the infant is not known.

In practice, however, progestin-only contraceptives are not widely available. Implants are still in the experimental stage (511). Only two progestin-only injectables, DMPA and NET EN, have been approved for use in a substantial number of countries, and some questions remain in dispute about other aspects of their acceptability and safety (see **Population Reports,** *Injectable Progestogens—Officials Debate but Use Increases*, K-1, March 1975).

Table 11. Retail Pharmacy Purchases of Progestin-Only Oral Contraceptives in Selected Countries, 1978–1981
(in thousands of cycles)

	1978	1979	1980	Jan.-June 1981
DEVELOPED AREAS				
Australia	333.4	353.0	381.6	208.9
Austria	6.8	6.9	6.9	4.3
Belgium	92.2	95.2	102.8	54.3
France	199.8	633.3	848.7	518.5
Germany	320.6	334.7	337.1	173.9
Greece	0.3	1.9	0.3	0.0
Japan[a]	24.6	26.9	21.2	8.5
Netherlands[b]	125.1	105.4	85.4	36.0
Portugal	12.5	15.9	21.9	11.0
South Africa	62.2	60.9	62.6	32.8
Spain	22.1	17.1	13.8	3.0
United Kingdom	642.3	1,079.1	1,527.8	814.3
United States	183.7	184.0	273.5	134.0
Subtotal	2,025.6	2,914.3	3,683.6	1,999.5
DEVELOPING AREAS				
Argentina	147.8	147.5	170.5	104.1
Brazil	424.1	451.0	583.1	259.0
Mexico	95.3	93.3	80.5	41.5
Subtotal	667.2	691.8	834.1	404.6
TOTAL	2,o92.8	3,606.1	4,517.7	2,404.1

[a]Japan—data gathered at wholesale level
[b]Netherlands—includes all outlets, not just pharmacies

Source: IMS International study prepared for the Population Information Program, 1981

Oral progestins, although approved for use in many countries and gaining in popularity, have not yet been widely adopted and may be difficult to obtain (see **Population Reports**, *Minipill—A Limited Alternative for Certain Women*, A-3, September 1975). During the last three years sales of progestin-only oral contraceptives have nearly doubled in the major sales areas, increasing from 2.7 million cycles in 1978 to almost the same quantity in just the first six months of 1981 (see Table 11)(650). The largest increases have occurred in France, where progestin-only pills constitute about 3 percent of all OC sales, and Britain, where they constitute 7 percent. In developing countries, however, where these formulations would be especially suitable because of the large number of women breast-feeding, sales have increased much less, and they are not generally available through family planning programs. USAID is hoping in 1982 to purchase and provide progestin-only pills on a limited basis for family planning programs.

Use of Combined Orals

At present, the issue of whether or when family planning programs should recommend or distribute combined oral contraceptives for breast-feeding women remains unresolved. The estrogen and progestin doses in combined pills have been reduced below the levels used in many early studies, with some reduction in the effects on breast milk. Moreover, all major studies using low-dose formulations, including the most recent, have found no significant effect on infant weight gain (79, 240, 288), even if volume of breast milk is diminished. A detailed 1981 nutritional study of breast milk components showed that milk volume, lactose, nitrogen, and several specific milk proteins all were altered by oral contraceptive use, but all remained within the normal range (345). In 1976 the International Pediatric Association warned that "contraceptive pills containing substances that are likely to sup-

press lactation or which may adversely affect the infant if excreted in breast milk must not be distributed to lactating women" (261). But the most recent statement of the American Academy of Pediatrics, Committee on Drugs, which was endorsed by the American College of Obstetricians and Gynecologists, Committee on Obstetrics, Maternal and Fetal Medicine, concludes that previous recommendations are "confusing," that "no unique effect of steroidal contraceptives on nursing mothers has been confirmed," and that in each case "an informed, individualized, and effective choice" should be made (20). National family planning and maternal and child health programs, no less than private physicians, need to be responsive to the needs and concerns of individual women.

Combined estrogen-progestin pills are one of the most widely used and preferred contraceptive methods, especially among younger women (see **Population Reports,** *OCs—Update on Usage, Safety, and Side Effects*, A-5, January 1979). They are readily available through family planning programs in many countries. A 1978 international survey of the practices of 754 physicians working with family planning associations in 65 countries shows that a high percentage of physicians have prescribed oral contraceptives for breast-feeding women (475, 523). Except in North America a high proportion also have prescribed progestin-only pills or injectables.

	% Ever Prescribing to Breast-Feeding Women		
Area	Combined Oral Pills	Progestin-Only Pills	Progestin-Only Injections
Africa	88	34	76
Asia	71	22	73
Latin America	63	27	36
Europe	40	67	52
Oceania	30	89	69
North America	26	19	9

The survey, conducted jointly by the IPPF and the United States Centers for Disease Control, also showed that more than half of the physicians in all regions provided voluntary sterilization, IUDs, and barrier methods to breast-feeding women (except for a lower percentage of European physicians providing sterilization). The major reason for providing combined oral contraceptives was the preference of the user, followed by the previous lactational history and use of feeding supplements. Less important were IPPF guidelines, regional or national policy, and local clinic policy. About 19 percent had received complaints about decreased milk production from women using combined orals, compared with 1 to 2 percent receiving complaints from women using IUDs or progestin-only pills or injectables (475, 523).

A review of World Fertility Survey data from 14 countries shows that from one to 10 percent of breast-feeding women use oral contraceptives, except in Indonesia, where 20 percent of breast-feeding women use orals (432) (see Table 12). In general, women using orals tend to be younger, to live in urban areas (except in Indonesia), to be better educated, and to have had more live births. Generally, women who have breast-fed longer are more likely to be using orals, suggesting that most women wait for some months postpartum before starting pills. In four countries, however—Costa Rica, Fiji, Indonesia, and Jamaica—5 percent or more of women at some point during the first three months of breast-feeding were using orals (432). In a study of over 2,000 women in Lagos, 7 percent—almost half of all those who had used contraception—had taken orals while breast-feeding their last child (406, 661).

The WHO Collaborative Study on Breast-feeding, although not involving strictly representative samples, shows that, among the women in various countries surveyed who were using oral contraceptives, 18 to 40 percent began while still breast-feeding. Up to 23 percent began before their breast-feeding child was three months old (605). This is hardly surprising, since 10 to 25 percent were menstruating by three months (see Figure 6, p. J-539).

There are at least two reasons that family planning and health centers provide oral contraceptives in spite of unresolved questions about adverse effects. First, there is the danger that if women want to use orals and are advised they cannot do so while breast-feeding, they may discontinue breast-feeding in order to use orals. As Franz Rosa observes, forcing women to make this choice has "disasterous implications for infant health in areas where there are no suitable alternatives to breast-feeding" (481). Although no systemmatic research has been undertaken on this issue, there is some evidence that women do stop breast-feeding in order to start oral contraception (479, 482, 625).

Second, without contraception, one of the greatest health risks a woman faces even during early breast-feeding is pregnancy. The adverse effects of closely spaced births on both mother and child have been fully documented (141, 352, 461). In most cases pregnancy appears to diminish the supply of breast milk (see box, p. J-553). These hazards must be weighed against any potential risk of using oral contraceptives. Moreover, over time, as the risk of pregnancy increases, any risks to the child of using hormones diminish because breast milk becomes a smaller part of the diet.

Table 12. Percentage of Ever-Married Women Currently Breast-Feeding, by Contraceptive Use, in 14 Developing Countries, World Fertility Survey Data, 1975–1978

Region, Country & Survey Date	% Currently Breast-Feeding	% Currently Breast-Feeding and Using:				% Currently Using Contraception
		Any Method	Pill	Injection	IUD	
AFRICA						
Kenya 1977	40.1	2.1	0.7	0.0	0.1	6
ASIA & MIDDLE EAST						
Bangladesh 1975–76	43.5	4.1	1.7	0.2	0.1	7
Fiji 1974	14.1	5.9	0.9	0.1	0.4	39
Indonesia 1976	32.4	10.7	6.5	0.1	1.6	23
Jordan 1976	27.5	3.8	1.6	0.2	0.3	24
Korea, Rep. of 1974	22.5	4.7	1.2	0.0	1.3	32
Sri Lanka 1975	30.1	10.4	0.5	0.1	1.7	29
LATIN AMERICA & CARIBBEAN						
Colombia 1976	15.4	3.8	0.9	0.0	0.6	37
Costa Rica 1976	6.1	2.9	0.6	0.1	0.1	58
Dominican Rep. 1975	15.4	2.5	0.4	0.0	0.2	27
Guyana 1975	9.9	2.1	0.5	0.0	0.5	29
Jamaica 1975–76	10.8	3.3	0.8	1.0	0.0	35
Panama 1976	11.1	2.8	0.6	0.0	0.1	48
Peru 1977–78	25.7	5.0	0.3	0.1	0.1	28

Note: Women were age 15–49 except in Costa Rica and Panama, 20–49. In Latin America and the Caribbean "married" includes legal and informal marriages.

Source: adapted from Pebley & Menken (432). % currently using contraception from Carrasco (637).

If, for whatever reason, combined oral contraceptives are used, several precautions might be advisable to minimize the risk of a reduction or other change in milk supply. Both clinic-based family planning workers and those involved in community-based distribution of combined estrogen-progestin pills should advise breast-feeding women:

1. Use the lowest available dose.
2. Do not initiate combined pills until lactation is well-established—at least two or three months postpartum. In a traditional rural society, six months postpartum might be the earliest date to consider initiating use unless menses resume earlier, and an even later date may be more appropriate in some settings where breast-feeding is prolonged and supplementation minimal.
3. Take each oral contraceptive tablet daily at the beginning of the longest interval between breast-feedings.
4. Provide additional suckling time when oral contraceptive use begins in order to help counteract any hormonal ef-

RESEARCH NEEDS

Both breast-feeding and family planning can be vital elements in improving maternal and child health. Among the many areas where more knowledge and new research would be useful are:

General and Basic Research

- The physiology of breast-feeding, including the hormonal basis for infecundity and hypothalamic function.
- Improved means of measuring milk quantity, milk composition, and suckling behavior that would be more accurate and/or make larger studies more feasible (330). Nonradioactive heavy water is one possibility for assessing the infant's daily milk intake (106).
- Effects of maternal nutrition on the quality and composition of breast milk.
- Effects of breast-feeding on the health of the mother, especially if she is poorly nourished.
- Adaptive mechanisms that may function in poorly nourished women to support lactation (347, 456).
- Development of growth standards for breast-fed infants.
- Optimal time to introduce supplementary foods for the infant under different circumstances.
- Breast-feeding patterns and the return of ovulation: how precisely can the aspects of breast-feeding that control the return of ovulation be defined? A few detailed studies are underway (260, 376). Also, several studies are being planned to see if measures of frequency of suckling and other breast-feeding behavior can be used to predict the return of ovulation for individual women (75, 185).

Research for Policy

- Current trends of breast-feeding in urban and rural areas throughout the world.
- Health and economic impact of breast- and bottle-feeding under different conditions.
- Reasons that women continue or discontinue breast-feeding. The Population Council, for example, is beginning a detailed survey of breast-feeding in Colombia, Indonesia, Kenya, and Thailand (680). A prospective study in the Philippines will explore the decision-making processes of low-income urban women with respect to infant feeding (669).
- Evaluation of the ways in which current scientific knowledge on various types of infant feeding is disseminated to health professionals (70).
- Evaluation of present medical, hospital, and health policies that affect breast-feeding.
- Evaluation of programs and policies to promote breast-feeding and discourage bottle-feeding.
- Evaluation of food supplementation programs for breast-feeding mothers: what are their effects on maternal health and child growth?

Research for Family Planning Programs

- Contraceptive practice of breast-feeding women and beliefs about fertility and sexual behavior while breast-feeding, so that programs can appeal specifically to breast-feeding women.
- When to initiate contraception, considered in terms of program effectiveness: what program strategies will yield the greatest health benefit and fertility reduction? WHO is testing various times to initiate different oral formulations in order to measure continuation rates and program effectiveness (635).
- Effects of family planning policies on breast-feeding—for example, do women stop breast-feeding in order to obtain pills from programs that will not provide them to breast-feeding women?

Research on Breast-Feeding and Contraception

- Differences between breast-feeding and non-breast-feeding women in the effectiveness, benefits, and risks of each contraceptive method, including voluntary sterilization. Differences among breast-feeding women by time of contraceptive initiation also need study. All new contraceptives should eventually be tested for breast-feeding as well as for non-breast-feeding women.
- Effects of various contraceptive methods on breast-feeding. More careful research is needed on the specific hormonal contraceptives currently in use and their effects on breast milk volume, milk composition, and hormone transmission in milk, including possible short- and long-term effects on the breast-fed child.
- Practical and reliable methods of identifying the first postpartum ovulation, to serve as a basis for more accurate advice on when modern methods of contraception should be initiated.
- The possibility of safe, systemic contraceptive methods that reinforce breast-feeding, assuring infecundity and promoting lactation at the same time. Drugs under consideration are thyrotropin releasing hormone (TRH), sulpiride, metaclopramide, and chlorpromacine, all of which raise prolactin levels but may have adverse effects as well (33, 376, 545, 550). TRH has increased milk production in some studies (283, 549, 550) but not in others (620, 623). Hyperthyroidism is a side effect of high doses (550). Sulpiride increased milk production in an Egyptian study, but its contraceptive effect was judged not adequate (33).

fect in reducing milk supply. If oral contraceptives are first taken at the same time that supplemental foods are added to the infant diet, a decline in milk supply should be expected, but breast-feeding can still be maintained. Breast milk will continue to benefit the child after other foods are introduced and after menses resume.

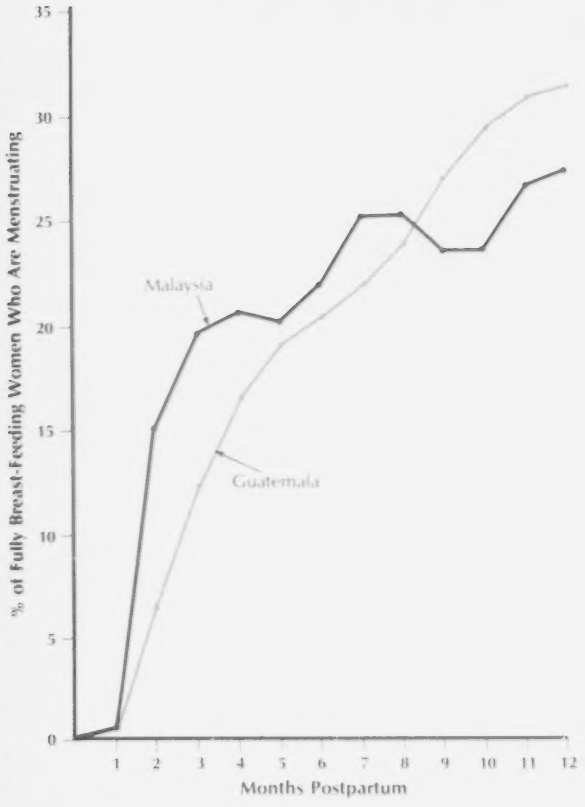
5. Encourage breast-feeding women who start the pill to continue for nine months or longer (50), since continuation rates strongly influence long-term effectiveness.

Above all, family planning and health workers should be sure that breast-feeding women know three important facts:

- that breast-feeding is the best way to protect infant health and, even after food supplementation begins, remains an important element of infant nutrition,
- that the amount of infant suckling is the strongest influence on the amount of breast milk,
- that, after three to six months, depending on breast-feeding practices, and particularly after menses resume, breast-feeding does not provide adequate protection against pregnancy, and effective contraception is needed.

Family planning workers can help breast-feeding women by encouraging them to continue breast-feeding and by keeping women's personal choice and concerns about breast-feeding in mind when providing family planning services.

Figure 9. Percentage of Fully Breast-Feeding Women Who Have Resumed Menstruating, by Month Postpartum, Guatemala and Malaysia



Source: Butz (71)

Among fully breast-feeding Guatemalan and Malaysian women, about 20 percent were menstruating at six months, a sign that many women have a real need for contraception while breast-feeding.

Options for Family Planning Programs

These suggested policies are offered as reasonable options, based on current knowledge:

- All women should be encouraged to breast-feed their children initially and for as long as feasible.
- Extra food for the mother should begin at the start of pregnancy and continue throughout lactation to help maintain the mother's nutritional status and perhaps also to improve her breast-feeding performance.
- Breast milk alone is usually sufficient for the infant until four to six months of age if the mother is adequately nourished. After four to six months an infant should receive supplemental feedings.
- A **fully** breast-feeding woman usually does not need contraception before six months postpartum. Sometimes, however, IUD insertion or voluntary sterilization can be performed just after delivery. Supplies and instructions for other methods can be provided then or at a postpartum checkup.
- To minimize any adverse impact on milk volume or length of lactation, or any drug transfer, progestin-only pills may be the best hormonal method, followed by injectables or the lowest available dose of combined pills (0.05 mg or less estrogen). The US Agency for International Development (USAID) plans a limited purchase of progestin-only pills in 1982. Where progestin-only methods are not available, the advantages of low-dose combined pills in preventing another pregnancy—with its reduction in milk supply and strain on maternal health—may outweigh any potential disadvantages.
- No universal rule is possible to determine when a breastfeeding woman can start hormonal methods. A woman who allows frequent suckling day and night with little supplementation and is not menstruating might reasonably wait 12 or 18 months to start combined pills or might start progestin-only methods earlier. A woman on a 3- to 4-hour, day-only feeding schedule who gives the infant other food early might reasonably start two or three months after delivery.
- Waiting for first menses involves some risk of pregnancy, but after first menses effective contraception is essential. Supplies and instructions should be ready in advance.
- To maintain adequate milk supply, frequent suckling should be encouraged. When mothers start hormonal contraceptives, they should be cautioned about changes in their activities that might interfere with the frequency and duration of suckling.
- Family planning programs should provide a range of methods, including hormonal and nonhormonal methods, for breast-feeding women. Programs that either do not offer nonhormonal methods or discourage use of hormonal methods during lactation may increase the risk that women will stop breast-feeding in order to use the method which is available or preferred or, alternatively, that they will become pregnant while breast feeding.

TABLES

Note: Studies were included in Tables 3-6 if they involved at least 20 women in each group using hormonal contraceptives, included a comparison group, and specified the hormonal components of the contraceptive. Unless otherwise stated, contraceptive was administered orally. Levonorgestrel and *d*-norgestrel are the same compound, as are norethindrone and norethisterone.

EE = ethinyl estradiol; ME = mestranol; DMPA = depot medroxyprogesterone acetate (Depo-Provera); NET EN = norethindrone enanthate (Noristerat).

Table 3. Selected Studies of Combined Estrogen-Progestin or Estrogen-Only Contraceptives That Found No Impact or Beneficial Impact on Breast-Feeding Performance

Author, Date, Ref. No. & Place	Formulation of Hormonal Contraceptive (in mgs)	No. of Women	Initiation (Time Post-partum)	Length of Observation	Compared With:	Criteria Used to Measure Breast-Feeding	Results
Begun within one week postpartum							
Toaff et al. 1969 (538) Israel	EE 0.3 (estrogen only)	66	1 day	5 days	46 placebo users; 63 using progestin-only OC (see Table 5). (Pills randomly allocated, double-blind.)	Milk quantity by test weighing	NSS
Begun at various times postpartum							
Semm 1966, Semm & Dittmar 1966 (502, 503) West Germany	Lynestrenol 2.5 + ME 0.075 (Lyndiol 2.5)	50	1 day	1 month	Placebo users, 50 in 1-day group, 35 in 10-day group (randomly allocated, double-blind)	Milk quantity by test weighing	For OC and placebo begun 1 day postpartum, NSS. Begun at 10 days, quantity somewhat higher with OC than with placebo.
		35	10 days				
Begun more than one week postpartum							
Campodonico et al. 1978 (79) Chile	Levonorgestrel 0.15 + EE 0.03 (Nordette)	60	25-30 days	3 months	45 IUD users (Lippes Loop or Copper T) (see Table 10); 45 noncontraceptors.	Infant weight gain; % still breast-feeding; % still fully breast-feeding.	Weight gain, NSS. Lower % with IUD (SS). NSS
Garcia et al. 1963 (164) Puerto Rico	Norethynodrel 2.5 + ME 0.1 (Enovid)	34	3 weeks	NR	Previous breast-feeding experience. Also studied: 187 users of higher OC doses (see Table 4).	Mothers' impressions of lactation	NSS
Guiloff et al. 1974 (195) Chile	Norethindrone 1.0 + EE 0.05	40	30 days	≥ 10 months	Previous breast-feeding experience of all 385 participants using various contraceptive methods, randomly assigned (see Tables 4, 5, and 10).	Median duration of breast-feeding	NSS
Prema 1981 (454) India	*d*-Norgestrel 0.15 + EE 0.05	52	≥ 6 months	3 years	1,917 noncontraceptors; 55 sterilized women; 68 IUD users (see Table 10); 73 using progestin-only injectables (see Table 6). Also, previous breast-feeding experience.	Duration of breast-feeding; Mothers' impressions of breast milk output during first month of contraceptive use.	Duration of breast-feeding similar for all groups and similar to previous experience. No abrupt decrease in milk output observed during first month of use.
	d-Norgestrel 0.15 + EE 0.03	50					

Table 4. Selected Studies of Combined Estrogen-Progestin Contraceptives that Found Adverse Impact on Breast-Feeding Performance

Author, Date, Ref. No. & Place	Formulation of Hormonal Contraceptive (in mgs)	No. of Women	Initiation (Time Post-partum)	Length of Observation	Compared With:	Criteria Used to Measure Breast-Feeding	Results
Begun within one week postpartum							
Kaern 1967 (288) Denmark	Norethisterone 1.0 + ME 0.05 (Norinyl 1)	212	1 day	7 days	206 placebo users (pills randomly allocated, double-blind)	% starting breast-feeding; Mothers' impressions of need for supplementary feeding; Infant weight gain.	NSS; Higher for OC users (SS); NSS

NR = not reported. NSS = difference not statistically significant. SS = difference statistically significant.

Table 4 continued

Author, Date, Ref. No. & Place	Formulation of Hormonal Contraceptive (in mgs)	No. of Women	Initiation (Time Post-partum)	Length of Observation	Compared With:	Criteria Used to Measure Breast-Feeding	Results
Begun more than one week postpartum							
Garcia et al. 1963 (164) **Puerto Rico**	Norethynodrel 19.7 + ME 0.3	22	3 weeks	NR	Previous breast-feeding experience	Mothers' impressions of lactation	% stating that they lactated less than previously increased with the dose. (No effect at dose of norethynodrel 2.5 + ME 0.1 (see Table 3).)
	Norethynodrel 9.85 + ME 0.15	37					
	Norethynodrel 5.0 + ME 0.075	84					
Gomez-Rogers 1967 (174) **Chile**	Norethisterone acetate 1.0 + EE 0.05 (Minovlar)	40	1–2 months	≥ 10 months	150 noncontraceptors; 81 IUD users (see Table 10); 103 using progestin-only injectables (see Table 5). Also, previous breast-feeding experience.	Median duration of breast-feeding.	Duration significantly shorter for both OC groups than for their previous experience and shorter than for all comparison groups.
	Chlormadinone acetate 1.5 + ME 0.08 (sequential)	52					
Guiloff et al. 1974 (195) **Chile**	Quingestanol acetate 5.0 + quinestrol 2.0 (monthly)	194	30 days	≥ 10 months	Previous breast-feeding experience of all 385 participants using various contraceptive methods, randomly assigned. (See Tables 3, 5, and 10.)	Median duration of breast-feeding	Duration significantly shorter than combined previous experience
	Quingestanol acetate 2.5 + quinestrol 2.0 (monthly)	81					
	Chlormadinone 1.5 + ME 0.08 (sequential)	52					
Gupta et al. 1974, 1977 (197, 198) **India**	Norgestrel 0.5 + EE 0.05 (Primovlar)	34	6 weeks	4.5 months	Nonhormonal group: 28 using female sterilization and 14 using other methods; 30 using progestin-only OCs (see Table 5). (Pills allocated according to women's endocrine profiles.) Pretreatment experience.	Milk quantity by test weighing and breast pump; Number of supplementary feedings.	Significant reduction in milk quantity for women using the 2 combined pills but not for the progestin-only and nonhormonal groups. More supplementary feedings by users of combined pills.
	Norethisterone acetate 1.0 + EE 0.05 (Minovlar)	30					
Huber et al. 1980 (240) **Bangladesh**	Norethindrone 1.0 + ME 0.05 (Noriday 1+50)	85	6–18 months (mean 6.8 months)	4 months (mean duration of use 9.4 months)	Nonhormonal group: 76 users of female sterilization and 27 using other nonhormonal methods or no contraception; 75 using progestin-only injectable (see Table 5).	Weight for age; Weight for length; Mothers' impressions of breast milk quantity; Number of supplementary feedings per day; 24-hour breast milk quantity and caloric content for some.	Weight for length increased in all 3 groups, with weight gain for OC group intermediate between nonhormonal group (low) and injectables group (high). Reduced milk quantity and more supplementary feedings in OC group. Calorie differences NSS.
Ibrahim & El-Tawil 1968 (254) **Egypt**	Ethynodiol diacetate 0.5 + ME 0.1 (Ovulen 0.5)	47	1–4+ months	6 months	Comparison among times pill use began	Duration of lactation	Duration of lactation shorter in women who initiated pill use earlier.
Kamal et al. 1969 (291) **Egypt**	Lynestrenol 2.5 + ME 0.075 (Lyndiol 2.5)	NR	6–10 weeks	Up to 32 weeks	Unreported number using progestin-only OC (lynestrenol 0.5) or IUD plus placebo (see Tables 5 and 10); Previous breast-feeding experience. (Double-blind: 120 participants in study.)	Infants' growth curves; Age at supplementation and weaning; Women's impressions of breast size and fullness and of adequacy of milk supply; Milk quantity by test weighing and breast pump; Feed-to-weight adequacy.	Growth curves, NSS. Other measures gave inconsistent results. Milk yields rose and then declined for lynestrenol 2.5 + ME 0.075, and declined steadily for all others. Performance ranked best-to-worst: placebo, lynestrenol 1.0 + ME 0.1, injection, lynestrenol 2.5 + ME 0.075.
	Lynestrenol 1.0 + ME 0.1 (Lyndiol 1.0)						
	Dihydroxyprogesterone acetophenide 150 + estradiol enanthate 10 (injection)						

NR = not reported NSS = difference not statistically significant SS = difference statistically significant

Table 4 continued

Author, Date, Ref. No. & Place	Formulation of Hormonal Contraceptive (in mgs)	No. of Women	Initiation (Time Post-partum)	Length of Observation	Compared With:	Criteria Used to Measure Breast-Feeding	Results
Koetsawang et al. 1972 (312) **Thailand**	Ethynodiol diacetate 1.0 + ME 0.1 (Ovulen)	20	6 weeks	16 weeks (10 weeks use)	20 using nonhormonal contraception	Milk quantity by breast pump; Infant weight gain.	Weight gain and milk volume less than in controls (SS). Weekly weight gain: Ovulen 147 g C-Quens 180 g Controls 202 g Volume at 16 weeks: Ovulen 37 ml C-Quens 56 ml Controls 82 ml
	Chlormadinone acetate 2.0 + ME 0.08 (C-Quens)	20					
Kora 1969 (316) **India**	Ethynodiol diacetate 1.0 + ME 0.1 (Ovulen)	62	4–24 weeks	2 months	15 using nonhormonal contraception. Pretreatment experience, analyzed by age of infant.	Milk quantity by test weighing; Infant weight gain.	Both criteria less for OC users than for nonusers or pretreatment group (SS).
Miller & Hughes 1970 (381) **US**	Norethindrone 1.0 + ME 0.08	24	2 weeks	3 months	48 using nonhormonal contraception; Pretreatment experience of 23 who started with placebo but were switched to OCs. (Random allocation of OC initiation time (2 or 6 weeks), double-blind.)	First 6 weeks: milk volume by test weighing; infant weight gain; supplementary feeding (number of calories). First 3 months: duration of breast-feeding; inadequate milk supply as reason for stopping breast-feeding.	Maternal milk production during first 6 weeks (as assessed by all three methods) was less for OC than for placebo group: 15% less milk, 3 oz. less weight gain in 5th week. % still breast-feeding at 3 months highest for control group, lowest for those starting OCs 2 weeks postpartum. Inadequate milk cited by more OC users.
		23	6 weeks (after placebo for days 14–34)	2 months			

Table 5. Selected Studies of Progestin-Only Contraceptives That Found No Impact or Beneficial Impact on Breast-Feeding Performance

Author, Date, Ref. No. & Place	Formulation of Hormonal Contraceptive (in mgs)	No. of Women	Initiation (Time Post-partum)	Length of Observation	Compared With:	Criteria Used to Measure Breast-Feeding	Results
Begun within one week postpartum							
Agoestina & Biben 1976 (17) **Indonesia**	DMPA 150 (Depo-Provera) 3-month injection)	100	2–4 days	12 weeks	75 not using hormonal contraception	Milk quantity by breast pump	Milk quantity greater than for controls.
Badraoui et al. 1977 (631) **Egypt**	DMPA 300 (monthly injection)	25	≤2 hours	1 year	238 diaphragm users and nonconcraceptors evaluated in earlier study (221)	Milk quantity by breast pump; Infant weight gain.	Milk quantities similar for all 4 treatment groups. Infant weights within normal range for all groups; highest with DMPA and dihydroxyprogesterone acetophenide.
	Dihydroxyprogesterone acetophenide 150 (monthly injection) (Deladroxone)	25					
	Quingestanol acetate 0.3	25					
	Chlormadinone acetate 0.5	25					
Casares Ponce 1969 (88) **Mexico**	Chlormadinone acetate 0.5	25	2 days	6 months	Infant weight standards of Mexican Academy of Pediatrics	Infant weight gain Mothers'	Weight gain similar to standards.
Koetsawang et al. 1972 (313) **Thailand**	DMPA 150 (Depo-Provera) (3-month injection)	30	2–4 days	16 weeks	25 using nonhormonal contraception	Milk quantity by breast pump; Infant weight gain; Mothers' impressions.	Quantity greater (SS). NSS Excess milk reported by 1/2 users, none of controls.

NR = not reported NSS = difference not statistically significant SS = difference statistically significant

Table 5 continued

Author, Date, Ref. No. & Place	Formulation of Hormonal Contraceptive (in mgs)	No. of Women	Initiation (Time Post-partum)	Length of Observation	Compared With:	Criteria Used to Measure Breast-Feeding	Results
Ruiz-Velasco et al. 1979 (487) **Mexico**	NET EN 200	75	2 days	3 months	Previous breast-feeding experience	Mothers' impressions of milk quantity	In $^1/_2$, NSS; in $> ^1/_3$, increase over previous experience.
Toaff et al. 1969 (538) **Israel**	6-α-methyl-17-α-hydroxy-progesterone acetate 30	63	1 day	5 days	46 placebo users; 66 using estrogen-only OCs (see Table 3) (Pills randomly allocated, double-blind.)	Milk quantity by test weighing	NSS
Begun at various times postpartum							
Guiloff et al. 1974 (195) **Chile**	DMPA 250 (6-month injection)	80	1–2 days	≥ 10 months	Previous breast-feeding experience of all 385 participants, using various contraceptive methods, randomly assigned (see Tables 3, 4, and 10).	Median duration of breast-feeding	With DMPA at 1-2 or 30 days, duration longer than previously (SS). Duration less when begun postpartum than at 30 days, but still longer than controls. Others NSS.
	Chlormadinone acetate 250 (3-month injection)	33	30 days				
	Quingestanol acetate 0.3	54	30 days				
		81	30 days				
Karim et al. 1971 (298) **Egypt**	NET EN 200 (Noristerat) (3-month injection)	68	7 days	6 months	100 users of non-hormonal contraception	Infant weight gain; Milk quantity by test weighing and breast pump.	Milk volume and weight gain significantly greater for all treatment groups than for controls. (No supplementary food). Initiation time, NSS.
		57	6 weeks				
	DMPA 150 (Depo-Provera) (3-month injection)	51	7 days				
		55	6 weeks				
Seth et al. 1977 (504) **India**	NET EN 40 (implant)	23	6 days	8 months	15 using nonhormonal contraception; Previous breast-feeding experience.	Infant weight gain;	Weight gain and duration compared with nonusers, NSS.
		12	6 weeks			Duration of lactation;	Duration shorter than previously in NET EN group, longer in controls.
						Supplementary feeding.	More feeding by early NET EN group at 3 mo. (SS); NSS later.
Zañartu et al. 1976 (621, 622) **Chile**	DMPA 150 (Depo-Provera) (3-month injection) or 250–300 (6-month injection)	133	≤ 1 month	Up to 18 months	173 IUD users and noncontraceptors participating in study of breast-feeding education	Duration of breast-feeding	Longer for both hormonal contraceptive groups than controls (SS). Longer when first injection was at 4–6 months.
		206	1–3 months				
		67	4–6 months				
	Chlormadinone diacetate 0.6 (Clogestone)	100	3–10 months				
Begun more than one week postpartum							
Gomez-Rogers et al. 1967 (174) **Chile**	DMPA 500 (6-month injection)	103	1–2 months	≥ 10 months	81 IUD users (see Table 10); 150 using no contraception; 92 using combined OCs (see Table 4). Previous breast-feeding experience of each group.	Median duration of breast-feeding	Longer than for all control groups (SS) except IUD users, where duration similar.
Gonzalez 1970 (175) **Mexico**	Chlormadinone acetate 0.5	50	5–40 days (later in 4 cases)	9 months	Infant weight standards of Mexican Academy of Pediatrics	Infant weight gain	NSS

NR = not reported NSS = difference not statistically significant SS = difference statistically significant

Table 5 continued

Author, Date, Ref. No. & Place	Formulation of Hormonal Contraceptive (in mgs)	No. of Women	Initiation (Time Post-partum)	Length of Observation	Compared With:	Criteria Used to Measure Breast-Feeding	Results
Gupta et al. 1974, 1977 (197, 198) **India**	Norgestrel 0.05	30	6 weeks	4.5 months	Nonhormonal group: 28 using female sterilization and 14 using other methods; 64 using combined OCs (see Table 4). (Pills allocated according to women's endocrine profiles.) Pretreatment experience.	Milk quantity by test weighing and breast pump; Number of supplementary feedings.	NSS
Hefnawi et al. 1976 (223) **Egypt**	DMPA 300 (monthly injection)	25	≤1 month	1 year	238 diaphragm users and noncontraceptors evaluated in earlier study (221). Also studied: 25 users of another progestin-only OC (see Table 6).	Milk quantity by breast pump	Milk yield higher than for controls
	Dihydroxyprogesterone acetophenide 150 (monthly injection) (Deladroxone)	25					
	Quingestanol acetate 0.3	25					
Huber et al. 1980 (240) **Bangladesh**	DMPA 150 (Depo-Provera) (3-month injection, except 450 mg for 6 months for ¼ of women initially)	75	6–18 months (mean duration 7.0 months)	4 months (mean duration of use 9.7 months)	Nonhormonal group: 76 using female sterilization and 27 using other methods or no contraception; 85 using combined OCs (see Table 4).	Weight for length; Mothers' impressions of breast milk quantity; Number of supplementary feedings per day; 24-hour breast milk quantity and caloric content for some.	Greater weight gain, smaller % reporting less milk among users than in nonhormonal group (SS). Other criteria: differences from nonhormonal group NSS.
Kamal et al. 1969 (291) **Egypt**	Lynestrenol 0.5	NR	6–10 weeks	5 months	Unreported number using IUD plus placebo or combined OCs (double-blind; see Tables 4 and 10). Previous breast-feeding experience. (120 participants in study.)	Age at supplementation and weaning; Women's impressions of breast size and fullness and of adequacy of milk supply; Milk quantity by test weighing and breast pump; Feed-to-weight adequacy; Infants' growth curves.	Results of various measures inconsistent but, overall, progestin-only ranked better than controls using IUD plus placebo.
Pal et al. 1979 (427) **India**	Norethindrone acetate 0.4 (implant)	25	6 weeks	6 months	25, contraceptive status not specified	Mothers' impressions of need for supplementary feeding	Fewer implant users felt supplementary food was needed (SS).
Prema 1981 (454) **India**	DMPA 150 (Depo-Provera) (3-month injection)	22	≥3 months	3 years	1,917 noncontraceptors; 55 sterilized women; 68 IUD users (see Table 10); 102 users of combined OCs (see Table 3). Also, previous breast-feeding experience.	Duration of breast-feeding; Mothers' impressions of breast milk output during first month of contraceptive use.	Duration of breast-feeding similar for all groups and similar to previous experience. No abrupt decrease in milk output observed during first month of use.
	NET EN 20 (monthly injection)	51	≥6 months				

NR = not reported NSS = difference not statistically significant SS = difference statistically significant

Table 6. Selected Studies of Progestin-Only Contraceptives That Found Adverse Impact on Breast-Feeding Performance

Author, Date, Ref. No. & Place	Formulation of Hormonal Contraceptive (in mgs)	No. of Women	Initiation (Time Post-partum)	Length of Observation	Compared With:	Criteria Used to Measure Breast-Feeding	Results
Begun more than one week postpartum							
Hefnawi et al. 1976 (223) **Egypt**	Chlormadinone acetate 0.5	25	≤1 month	1 year	238 diaphragm users and noncontraceptors evaluated in earlier study (221). Also studied: 75 using other progestin-only contraceptives (see Table 5).	Milk quantity by breast pump	Milk yield lower than for controls and for other progestin-only formulations.

Note: Studies were included in Tables 7-8 if they involved at least 10 women in each group using hormonal contraceptives, included a comparison group, and specified the hormonal components of the contraceptive. Unless otherwise stated, contraceptive was administered orally. Levonorgestrel and *d*-norgestrel are the same compound, as are norethindrone and norethisterone.

EE = ethinyl estradiol; ME = mestranol; DMPA = depot medroxyprogesterone acetate (Depo-Provera); NET EN = norethindrone enanthate (Noristerat).

+ = significantly greater in cases than in controls
0 = no significant difference between cases and controls
- = significantly less in cases than in controls

Table 7. Selected Studies of the Effect of Combined Estrogen-Progestin or Estrogen-Only Contraceptives on Breast Milk Composition

Author, Date, Ref. No. & Place	Formulation of Hormonal Contraceptive (in mgs)	No. of Women	Initiation (Time Post-partum)	Length of Observation	Compared With:	Effect on Milk Components		
						Protein	Fat	Lactose
Begun within one week postpartum								
Toaff et al. 1969 (538) **Israel**	EE 0.3 (estrogen only)	66	1 day	5 days	46 using placebos; Also studied: 63 using progestin-only OCs (see Table 8). (Pills randomly allocated, double-blind.)	+	0	0
Begun at least one week postpartum								
Abdel-Kader et al. 1969 (12) **Egypt**	Lynestrenol 2.5 + ME 0.075 (Lyndiol 2.5)	10	6-10 weeks	16 weeks	10 using IUD plus placebo; comparison with pretreatment milk. Also studied: 100 using progestin-only contraceptives (see Table 8).	–	–	0
	Lynestrenol 1.0 + ME 0.1 (Lyndiol 1.0)	10				–	–	0
	Dihydroxyprogesterone acetophenide 150 + estradiol enanthate 10 (monthly injection) (Deladroxate)	10				–	–	0
Barsivala & Virkar 1973 (43) **India**	Norgestrel 0.5 + EE 0.05 (Ovral)	16	1-9 months	3 cycles	8 using conventional methods; comparison with pretreatment milk. Also studied: 15 using progestin-only contraceptives (see Table 8).	–		0
Gupta et al. 1974, 1977 (197, 198) **India**	Norgestrel 0.5 + EE 0.05 (Primovlar)	34	6 weeks	3 months	28 sterilized women and 14 using other nonhormonal methods; comparison with pretreatment milk. Also studied: 30 using progestin-only contraception (see Table 8). (Pills allocated according to women's endocrine profiles.)	0	0	0
	Norethisterone acetate 1.0 + EE 0.05 (Minovlar)	30				0	0	0

Table 7 continued

Author, Date, Ref. No. & Place	Formulation of Hormonal Contraceptive (in mgs)	No. of Women	Initiation (Time Post-partum)	Length of Observation	Compared With:	Effect on Milk Components: Protein	Fat	Lactose
Huber et al. 1980 (240) **Bangladesh**	Norethindrone 1.0 + ME 0.05 (Noriday 1 + 50)	40	Mean about 7 months	2 days	Nonhormonal group: 49 using female sterilization, condom, other nonhormonal methods, or no method. Also studied: 30 using progestin-only contraceptives (see Table 8).	0	+	0
Ramadan et al. 1972 (464) **Egypt**	Chlormadinone acetate 3.0 + ME 0.1 (Ovosiston)	20	2–4 months	4 months	20, contraception not specified	–	+	0

Table 8. Selected Studies of the Effect of Progestin-Only Contraceptives on Breast Milk Composition

Author, Date, Ref. No. & Place	Formulation of Hormonal Contraceptive (in mgs)	No. of Women	Initiation (Time Post-partum)	Length of Observation	Compared With:	Effect on Milk Components: Protein	Fat	Lactose
Begun within one week postpartum								
Badraoui et al. 1977 (631) **Egypt**	DMPA 300 (monthly injection)	25	≤2 hours	1 year	238 diaphragm users and noncontraceptors, evaluated in earlier study (13)	0	NR	NR
	Dihydroxyprogesterone acetophenide 150 (monthly injection) (Deladroxone)	25				0	NR	NR
	Chlormadinone acetate 0.5	25				0	NR	NR
	Quingestanol acetate 0.3	25				0	NR	NR
Koetsawang et al. 1972 (312) **Thailand**	DMPA 150 (Depo-Provera) (3-month injection)	30	2–4 days	16 weeks	25 users of nonhormonal contraception	0	0	0
Toaff et al. 1969 (538) **Israel**	6-α-methyl-17-α-hydroxyprogesterone acetate 30	63	1 day	5 days	46 placebo users. Also studied: 66 using estrogen-only OC (see Table 8). (Pills randomly allocated, double-blind.)	0	0	0
Begun at various times postpartum								
Karim et al. 1971 (298) **Egypt**	NET-EN 200 (Noristerat) (3-month injection)	68	7 days	6 months	100 using nonhormonal contraception	0	0	0
		57	6 weeks			0	0	0
	DMPA 150 (Depo-Provera) (3-month injection)	51	7 days			0	0	0
		55	6 weeks			0	0	0
Seth et al. 1977 (504) **India**	Norethindrone acetate 40 (implant)	23	6 days	8 months	15 using nonhormonal methods	0	NR	0
		12	6 weeks			0	NR	0
Begun at least one week postpartum								
Abdel-Kader et al. 1969 (12) **Egypt**	Lynestrenol 0.5	10	6–10 weeks	16 weeks	10 using IUD plus placebo; comparison with pretreatment milk. Also studied: 30 using combined OCs (see Table 7).	–	–	0
Abdel Kader et al. 1976 (11) **Egypt**	DMPA 300 (monthly injection)	25	≤1 month	1 year	238 diaphragm users and noncontraceptors, evaluated in earlier study (13); comparison with pretreatment milk.	+	0	0
	Dihydroxyprogesterone acetophenide 150 (monthly injection) (Deladroxone)	25				+	0	0
	Chlormadinone acetate 0.5	25				+	0	0
	Quingestanol acetate 0.3	25				0	0	0

Table 8 continued

Author, Date, Ref. No. & Place	Formulation of Hormonal Contraceptive (in mgs)	No. of Women	Initiation (Time Post-partum)	Length of Observation	Compared With:	Effect on Milk Components		
						Protein	Fat	Lactose
Barsivala & Virkar 1973 (43) **India**	Megestrol acetate 0.5	15	1–9 months	3 cycles	8 using barrier methods: comparison with pretreatment milk. Also studied: 16 using combined OCs (see Table 7).	0	0	0
Gupta et al. 1974, 1977 (197, 198) **India**	Norgestrel 0.05 + EE 0.05 (Primovlar)	30	6 weeks	3 months	28 sterilized women and 14 using other nonhormonal methods: comparison with pretreatment milk. Also studied: 64 using combined OCs (see Table 7). (Pills allocated according to user's endocrine profile.)	0	0	0
Huber et al. 1980 (240) **Bangladesh**	DMPA (Depo-Provera) (injection, 150 mg every 3 months except 450 mg for first 6 months for 1/4 of women)	36	Mean about 7 months	2 days	49 using female sterilization, other nonhormonal methods, or no contraception. Also studied: 40 using combined OCs (see Table 7).	0	0	0
Pal 1979 (427) **India**	Norethindrone acetate 40 (implant)	25	6 weeks	6 months	25 using nonhormonal methods.	–	0	0
Sammour et al. 1973 (490) **Egypt**	Chlormadinone acetate 0.5	20	2–4 months	3 months	20; contraception not specified.	–	0	0

NR = not reported

Table 9. Selected Studies of the Transmission of Hormonal Contraceptive Components in Breast Milk

Author, Date, Ref. No. & Place	Hormone & Dose (in mgs)[a]	No. of Women	Initiation (Time Post-partum)	Length of Observation	Ratio of Concentrations in Plasma and in Milk	Mean Concentration in Milk (ng/ml)	Daily Dose to Infant (mg per 600 ml of Milk)	Daily Infant Dose as Proportion of Maternal Dose
Estrogens								
Nilsson et al. 1978 (412) **Sweden**	EE 0.05 (+ megestrol acetate 4.0) (Neo-Delpregnin)	4	8 weeks	1 day	Not detectable (ND)	ND (est. 0.015[b])	ND (est. 0.01[b])	ND (est. 0.0002[b])
Progestins								
Koetsawang 1977 (311) **Thailand**	DMPA 150 (Depo-Provera) (injection)	6	1–4 weeks	12 weeks	100:50[c]	<2–16.5	0.0012–0.0099	NR
Nilsson et al. 1977 (411) **Sweden**	*d*-Norgestrel 0.03 (Follistrel)	5	8 weeks	"As long as lactation lasted"[d]	ND	ND	ND	ND
	d-Norgestrel 0.15 (+ EE 0.03) (Neovletta)	5			100:15	0.25	0.00015	0.001
	d-Norgestrel 0.25 (+ EE 0.05) (Follinett)	5			100:15	0.50	0.00030	0.0012
Nilsson et al. 1977 (413) **Sweden**	Megestrol acetate 4.0 (+ EE 0.05) (Neo-Delpregnin)	5	8 weeks	NR	100:80	3.2	0.0019	0.0005
Saxena et al. 1977 (494) **UK**	DMPA 150 (Depo-Provera) (injection)	7	1 week	≤ 3 months	100:85[c]	0.5–2.3	0.00030–0.00138	NR
	Norethisterone 0.35 (Micronor)	5	≤ 1 month	1 day	100:18[c]	0.37[e]	0.00022[e]	0.0006[e]
	d-Norgestrel 0.15 (+ EE 0.03) (Nordette)	2	≤ 1 month	≤ 20 days	100:6	0.18[c]	0.00011[c]	0.0007[e]

Table 9 continued

Author, Date, Ref. No. & Place	Hormone & Dose (in mgs)[a]	No. of Women	Initiation (Time Post-partum)	Length of Observation	Ratio of Concentrations in Plasma and in Milk	Mean Concentration in Milk (ng/ml)	Daily Dose to Infant (mg per 600 ml of Milk)	Daily Infant Dose as Proportion of Maternal Dose
Thomas et al. 1977 (533) **Thailand**	*d*-Norgestrel 0.03	3	2 weeks	4–6 weeks	NR	0.074[c]	0.00044[c]	0.001[c]
Toddywalla et al. 1980 (540) **India**	Norethisterone acetate 1 (+ EE 0.03)	4	>6 months	1 day	~100:10	1.0[c]	0.006[c]	0.0006[c]
	d-Norgestrel 0.15 (+ EE 0.03)	4	>6 months	1 day	~100:10	0.25[c]	0.00015[c]	0.001[c]
	Norethisterone 0.035	4	>3 months	1 day	~100:10	0.3[c]	0.00018[c]	0.0005[c]
	d-Norgestrel 0.05	4	>3 months	1 day	~100:10	0.1 at 2 hours[c] (ND after 4 hours)	0.00006[c]	0.0012 at 2 hours[c] (<0.0006 after 4 hours[c])
	Norethisterone 25 (implant)	4	6–12 weeks	up to 6 months postpartum	~100:10	0.2 at 24 hours[c] (ND after 7 days)	0.00012 at 24 hours[c] (est. <0.00003 after 7 days[c])	NR
	d-Norgestrel 25 (implant)	4	6–12 weeks	up to 6 months postpartum	~100:10	0.1 at <24 hours[c] (ND after 24 hours)	0.00006 at 24 hours[c] (<0.00003 after 24 hours[c])	NR

ND = not detectable
NR = not reported

Note: Includes only studies in which steroids were administered to fully breast-feeding women and then measured by radioimmunoassays. Does not include early studies with radioactively labeled steroids administered to lactating, but not breast-feeding, women.

[a] Administered orally unless otherwise specified.
[b] Based on women receiving 0.5 mgs ethinyl estradiol to suppress lactation, but calculated proportionally for daily contraceptive dose of 0.05 mg.
[c] Calculated or estimated from reported data.

Table 10. Selected Studies of Effect of Intrauterine Devices (IUDs) on Breast-Feeding

Author, Date, Ref. No. & Place	Type of IUD	No. of Women	Initiation (Time Post-partum)	Length of Observation	Compared With:	Criteria Used to Measure Breast-Feeding	Results
Inserted within one week postpartum							
Hefnawi et al. 1975 (222) **Egypt**	Lippes Loop	150	Within 1 week	1 year	238 diaphragm users and noncontraceptors, evaluated in earlier study (221)	Milk quantity by breast pump	Not significantly different. (Milk composition also not significantly different.)
Hingorani & Uma Bai 1970 (231) **India**	Lippes Loop	185	3–7 days	3 years	106, contraception not specified	Duration of breast-feeding	Not significantly different
Inserted more than one week postpartum							
Campodonico et al. 1978 (79) **Chile**	Lippes Loop, Copper T	45	25–30 days	3 months	45 noncontraceptors; 60 using combined OCs (see Table 3).	Infant weight gain; % still breast-feeding; % still fully breast-feeding.	No significant differences in weight gain either for infants of all women or of fully breast-feeding women only. No significant differences in % still fully breast-feeding. Significantly higher % of IUD users stopped breast-feeding.
Gomez-Rogers et al. 1967 (174) **Chile**	NR	81	1–2 months	≥10 months	150 noncontraceptors; 195 using various hormonal contraceptives (see Tables 4 and 5). Previous breast-feeding experience of each group	Median duration of breast-feeding	Significantly longer for IUD users than their previous experience, than for noncontraceptors, and than for 2 of 3 hormonal contraception groups.

Table 10 continued

Author, Date, Ref. No. & Place	Type of IUD	No. of Women	Initiation (Time Post-partum)	Length of Observation	Compared With:	Criteria Used to Measure Breast-Feeding	Results
Guiloff et al. 1974 (195) **Chile**	Lippes Loop	81	30 days	≥ 10 months	Previous breast-feeding experience of all 385 participants, using various contraceptive methods, randomly assigned (see Tables 3, 4, and 5).	Median duration of breast-feeding	Significantly longer than combined previous experience. Also longer than current experience of all but one group of hormonal contraceptive users.
Kamal et al. 1969 (291) **Egypt**	NR (plus oral placebo)	NR	6–10 weeks	up to 32 weeks	Unreported number using hormonal contraceptives (double-blind) (see Tables 4 and 5). (120 participants in study.)	Age at supplementation and weaning; Woman's impressions of breast size and fullness and of adequacy of milk supply; Milk yield by test weighing and breast pump; Feed-to-weight adequacy; Infants' growth curves.	Overall, breast-feeding performance of IUD group was better than for 3 of the 4 hormonal contraceptive groups. Various measures gave inconsistent results, however. (No effect of IUD on milk composition (12).)
Osteria 1976 (420) **Phillipines**	NR	293	Mean 1-2 months	17 months	260 noncontraceptors; 71 using hormonal contraceptives; 170 using other methods.	Duration of breast-feeding	Longer for IUD users than for noncontraceptors and users of hormonal contraceptors but not as long as for users of other methods.
Prema 1981 (454) **India**	Copper T	68	NR	3 years	1,917 noncontraceptors; 55 sterilized women; 175 using hormonal contraceptives (see Tables 3 and 5). Previous breast-feeding experience.	Duration of breast-feeding	Duration of breast-study groups and compared with previous experience.

NR = not reported

Note: Studies were included in Table 10 if they involved at least 20 women in each group and used a comparison group. No studies show adverse clinical impacts of IUD use on breast-feeding.

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